EXPOSURE

POSTGRADUATE RESEARCH EXPOSITION

PROGRAMME

1-4 October 2018

auckland.ac.nz/exposure

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

ACHIEVE THE AMAZING

About the PGSA

The Postgraduate Students' Association is an incorporated society dedicated to strengthening the postgraduate community at the University of Auckland.

The association is run by a board of representatives from each faculty. Our vision is to create and foster a sense of identity and community for all postgraduate students and provide an effective voice promoting the distinct and unique academic, professional and school interests of postgraduates within the University and the wider community.

About the School of Graduate Studies

The School of Graduate Studies is located above AskAuckland Central in Alfred Nathan House on City Campus.

Our operations team advises current and prospective doctoral candidates on regulations, admissions, enrolment, programme administration, examination processes, thesis submission, annual report processes and dispute procedures.

The communications and engagement team produce Postgrad News, a fortnightly e-newsletter for all postgraduates. They also organise a range of events and activities for postgraduates, such as the Doctoral Morning Tea and the annual Three Minute Thesis Competition.

Contents

Exposure began as a PGSA initiative in 2003. Now organised with the School of Graduate Studies, Exposure is an opportunity for postgraduate students to showcase their work to an audience, gain public recognition, receive feedback and network with employers.

Students can enter the following categories:

1. UniServices Poster Display
2. Oral Presentation

Winners of each category have their names etched onto the Exposure Wall of Fame in the Postgraduate Lounge. The winners and two runners up from each category also receive certificates and generous cash prizes.

All events are open to staff and students of the University of Auckland and to members of the public.

Welcome letter

Dear students, staff, and all others here for Exposure this year

I'm pleased to welcome you all to the 2018 Exposure Postgraduate Research Exposition! Exposure is a one-of-a-kind event from the University of Auckland, a student-led collaboration between the Postgraduate Students' Association (PGSA) and the School of Graduate Studies intended to showcase the wide variety of research performed by talented postgraduate students across the University. Exposure is an exiting opportunity to share this research both within and outside of academia, wonderful prizes and celebrate the start of many successful academic careers. The week-long, conference-style exposition provides opportunities for postgraduates to showcase research through two key mediums: posters in the UniServices Poster Competition and presentations at the Oral Sessions. I commend the courage and hard work of all our participants in preparing and submitting their presentations this year - well done!

This is my second year now being involved with Exposure, and I have found it to be a fulfilling and friendly experience. I have learned new things, met new people and had an all-around excellent time. Exposure provides a platform to exhibit our University's student research close to home and see what our postgraduates have been working on during their degrees. It's amazing to think that the world-class research we see at Exposure is just a snapshot of the postgraduate research happening across the university, by students who will be attending conferences and presenting their work around the world. I hope that others will be inspired to follow this course by the work they see at this exposition.

As organisers and as students, we are extremely grateful to those who have supported and sponsored Exposure this year. I would like to thank our commercial and academic sponsors: UniServices, Displayways, and the Faculty of Creative Arts and Industries. We really couldn't have held this event without your support. I would also like to extend my thanks to the Exposure Committee, for their effort and persistence. I have to extend a very special thanks to Exposure Head Marilyn Chetty, whose own leadership and hard work have provided a shining beacon for the rest of the team to aspire to.

Most of all, I would like to thank all the entrants, judges and guests to Exposure this year. You are essential to holding this exposition year after year, and without you it couldn't exist. I hope everyone has a great time, whether presenting or not, and wish all those who have entered the competition the best of luck for their presentations!

Yours sincerely,

Zac Roberts
President of the Postgraduate Students' Association (PGSA)

Letter of support

Since 2003, Exposure has showcased research carried out by postgraduate students at the University of Auckland. Masters and doctoral candidates have enlightened, entertained and enthralled us with their poster displays and oral presentations. I am sure that entries this year will do the same.

With almost 3000 doctoral candidates and several hundred research masters students, the University of Auckland is a hotbed for postgraduate research. The theses being written, and the creative works being produced, will benefit our society, economy and nation. The School of Graduate Studies is delighted to work with the Postgraduate Students' Association on Exposure 2018. On behalf of the School, I would like to thank all of those who have made this exposition possible, from the organisers to the presenters, the sponsors to the judges. I am sure that Exposure 2018 will be a huge success.

Associate Professor Caroline Daley
Dean of Graduate Studies

Hosted by

PGSA
POSTGRADUATE STUDENTS ASSOCIATION
THE UNIVERSITY OF AUCKLAND

Sponsors

uniservices
IDEAS TO LIFE RANGAHAUA KIA WHAI HUA

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

CREATIVE ARTS AND INDUSTRIES

Our sincerest thanks to the faculties who were willing to support and sponsor Exposure 2018:

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Faculty of Creative Arts & Industries

Faculty of Medical and Health Science

Faculty of Science

2018 Exposure Committee

Exposure Chair	Marilyn Chetty
PGSA President	Zac Roberts
Secretary	Ripi Kaur
Sponsorship	Shreya Kanakiya
Communication	Weiyi (Thomas) Zhang, Tayaza Fadason
Registration	Joanna Selamat, James Hannam
School of Graduate Studies	Elisha Masemann, Sarah Cason, Nadine Schneemann
PGSA Administrator	Jo Malone

2018 Exposure judges

Prof. Rosalind Archer
Dr Rizwan Ashgar
Prof. Andrew Barrie
Dr Marion Blumenstein
Dr Caroline Blyth
Mrs Helen Borne
Prof. Deidre Brown
Prof. Toni Bruce
Mr Will Charles
Ms Megan Clark
Dr Richard Clarke
Mrs Margaret Crannigan Allen
Ms Diane Curry
Assoc. Prof. Caroline Daley
Dr Tia Dawes
Assoc. Prof. Kim Dirks
Ms Ashleigh Fox
Assoc. Prof. Julia Gatley
Dr Thomas Gregor
Dr Sara Hanning
Ms Derryl Hayman
Dr An Hertogen
Dr Josta Heyligers
Dr Jennifer Jones
Assoc. Prof. Vivien Kirk
Dr Alistair Kwan
Mr Kent Lee
Dr Sandy Lin
Assoc. Prof. Steve Matthewman
Dr Parizad Mulla
Dr Nira Paskaranandavdivel
Miss Alex Pennycuick
Mr Chris Rollins
Dr Helen Ross
Assoc. Prof. Luitgard Schwendenmann
Dr Nichola Shackleton
Dr Giriraj Singh Shekhawat
Dr Malvindar Singh-Bains
Dr Philip Turnbull
Assoc. Prof. Linda Tyler
Dr Faith Welch
Mr James Weston
Laura Zechel

Exposure calendar of events 2018

Event	Date	Venue	Time
Oral Session Prelims	1 Oct	Conference Centre Lecture Theatre (423-342) and Engineering Lecture Theatre (423-340)	8.30am-12.30pm 1.30pm-5.30pm
UniServices Poster Exhibition	1 – 2 Oct	Neon Foyer in Engineering	8.30am–5.30pm
Oral Session Finals	2 Oct	Conference Centre Lecture theatre 423-342	6pm-8pm
Prize Giving	4 Oct	Neon Foyer in Engineering	5.30pm-8pm

The University of Auckland Inventors' Fund

Open to both students and researchers to assist in the successful transformation of good research into good businesses and exciting new products. This early investment is the riskiest stage of the venture process and typically no other sources of risk capital are available.

PROOF OF CONCEPT AND SEED FUNDS

Auckland UniServices Limited brings to you the University of Auckland Inventors Fund (UoAIF), an "evergreen" open-ended $20m investment fund accessible to University researchers and students for the development of technologies for commercialisation.

For over 10 years UniServices has been providing early proof of concept and pre-seed investment to support the University's research discoveries, ensuring that they reach a point where commercial usefulness can be demonstrated and the first steps are taken to ensure commercial viability.

The availability of seed funds is critical to the commercialisation process in a number of ways – financing access to managerial skills; securing or enhancing intellectual property; supporting additional R&D; construction of prototype; preparation of business plan; covering legal costs and so forth.

In 2015, the University of Auckland made considerable funds available to expand UniServices investment activity.

This has meant that UniServices is now able to provide significant commercialisation support to student entrepreneurship.

FOR MORE INFORMATION, REFER TO:

http://tiny.cc/UOAIF

and to the University of Auckland IP policy at

http://tiny.cc/uoaip

uniservices
IDEAS TO LIFE

The University of Auckland
Inventors' Fund
Powered By UniServices

Timetable
Oral Presentations

Monday 1 October 2018
Venue: Conference Centre Lecture Theatre 423-342

Session 1: 8.30am–12.30pm		
Judging panel	**Faculty/Department**	
Dr Nichola Shackleton	Faculty of Arts	
Dr Marion Blumenstein	Faculty of Education and Social Work	
Mrs Helen Borne	Alumni Relations and Development	
Dr Rizwan Asghar	Faculty of Science	
Researcher	**Topic**	**Faculty**
Severi Luoto	Global Variation in Innovation and Economic Complexity: Insights From Evolutionary Science	Faculty of Arts
Sarah Mitchell	The Effect of a High Protein Diet on Gut Metabolites: A Randomised Controlled Trial	Liggins Institute
Fang Li	A Narrative Inquiry of Beginning Teachers' Meaning-making of Their Work as a Teacher	Faculty of Education and Social Work
Anthony Davies	Rewarming After Therapeutic Hypothermia for Neonatal Hypoxic-ischemic Encephalopathy – Is Fast or Slow Rewarming Better?	Faculty of Medical and Health Sciences
Stephen Lo	Derivatisation of Flavonoids Found in Food Waste to Enhance Bioactivity	Faculty of Science
Morning tea break		
Naomi Davies	Gut hormone and Gut Bacteria Changes in Patients with T2D Undergoing SG or RYGB Surgery	Faculty of Medical and Health Sciences
Andrew Chen	Towards Practical and Ethical Video Analytics Systems	Faculty of Engineering
Micah Daniel Austria	Characterising the Vascular Changes in the Alzheimer's Disease Human Brain Using Tissue Microarrays	Faculty of Medical and Health Sciences
Ruth Monk	Optimisation of Direct Cellular Reprogramming to Model Huntington's Disease	Faculty of Medical and Health Sciences

Session 3: 1.30pm–5.30pm		
Judging panel	**Faculty/Department**	
Assoc. Prof. Steve Matthewman	Faculty of Arts	
Dr Faith Welch	Research Strategy and Integrity	
Dr Philip Turnbull	Faculty of Medical and Health Sciences	
Prof. Toni Bruce	Faculty of Education and Social Work	
Researcher	**Topic**	**Faculty**
Kate Mackrill	Impact of Media Coverage on Venlafaxine-reported Side Effects Following a Nation-wide Drug Switch	Faculty of Medical and Health Sciences
Pania Bridge-Comer	The Role of IL-1 Signaling in Female Fertility and Reproductive Health	Liggins Institute
Linda Yu	Emotional Triggers in Thesis Proposal Writing: Chinese Doctoral Students' Intercultural Experiences	Faculty of Education and Social Work
Kar Yan Soh	Functional Analysis of Streptococcus Virulence Factors using a Zebrafish Infection Model	Faculty of Medical and Health Sciences
Afternoon tea break		
Rebecca Richards	CpG for ID: Forensic Applications of DNA Methylation Analysis	Faculty of Science
Grace Borichevsky	To Wnt5b or not to Wnt5b: Understanding the Role of Wnt5b in Lymphatic Specification	Faculty of Medical and Health Sciences
Scott Pilkington	How Do We Communicate Science in Museums in Aotearoa?	Faculty of Arts
Latha Karthigaa Murugesan	ECoS for Smart Homes	Faculty of Engineering
Sam Blanchett	PilVax: A Novel Peptide Carrier for the Development of Vaccines Against Tuberculosis	Faculty of Medical and Health Sciences

Monday 1 October 2018
Venue: Engineering Lecture Theatre 423-340

Session 2: 8.30am–12.30pm		
Judging panel	**Faculty/Department**	
Dr Thomas Gregory	Faculty of Arts	
Ms Megan Clark	Libraries and Learning Services	
Dr Niranchan Paskaranandavdivel	Auckland Bioengineering Institute	
Researcher	**Topic**	**Faculty**
Therese Kiely	"But who do you say I am?" - Images of God and NZ-Pacific Mental Wellbeing	Faculty of Arts
Farha Ramzan	Comprehensive Profiling of the Circulatory miRNAome Response to a High Protein Diet in Elderly Men	Liggins Institute
Su Mukund	Factors That Influence Science and Non-science Option Choices in Year 13 at New Zealand Secondary Schools: Students' Voices	Faculty of Education and Social Work
Marco Annandale	Effect of Glucose and Fructose Exposure on Cardiomyocyte Glycogen Handling	Faculty of Medical and Health Sciences
Marina Drazba	The Mountain That Walks	Faculty of Engineering
Morning tea break		
Kelly Peterken	Development of a Mucosal Vaccine Candidate for Staphylococcus aureus Using the Novel Carrier PilVax	Faculty of Medical and Health Sciences
Hemisha Priya	The Self-Phone: Impact of the Mere Presence of a Mobile Phone on Patient Satisfaction	Faculty of Medical and Health Sciences
Annie Jones	Using an Active Visualisation Device to Improve Adherence to Antiretroviral Therapy in South Africa	Faculty of Medical and Health Sciences
James Hucklesby	Plasmin System Proteins Regulate Endothelial Presentation of CCL21 and Subsequent T cell Extravasation	Faculty of Science

Session 4: 1.30pm–5.30pm		
Judging panel	**Faculty/Department**	
Miss Alexandra Pennycuick	Faculty of Arts	
Dr Malvindar Singh-Bains	Faculty of Medical and Health Sciences	
Dr Rosalind Archer	Faculty of Engineering	
Researcher	**Topic**	**Faculty**
Georgia Watson	The Role of the PACAP Receptor Extracellular Domain in Receptor Activation and Signalling	Faculty of Science
Tamsin Robb	Investigating Tumour Evolution in a Single Patient with Disseminated Cancer	Faculty of Medical and Health Sciences
Rebecca Griffith	Dextrose Gel for Prevention of Neonatal Hypoglycaemia May Improve Motor, Language, And Executive Function in Two-year-olds	Faculty of Medical and Health Sciences
Vishakha Mahajan	Ten Eleven Translocation Enzymes Exhibit Cell-Specific Differential Expression in Response to Steroid Hormones in Human Endometrium	Liggins Institute
Lakshini Dilesha Fernando Thewarashige	Self-cleaning Coatings for Pre-painted Steel Roofing	Faculty of Science
Afternoon tea break		
Sarah Appleby	Generating Immune-compatible Sheep for Xenotransplantation	Faculty of Medical and Health Sciences
Matthew Kang	Genetic Feto-Maternal Microchimerism	Faculty of Medical and Health Sciences
Isabela Monteiro	Nano-containers for Signals to Cells - When and Where They Are Needed	Faculty of Engineering
Robin Lane	An Ecology for Learning: Providing Teachers With The Right Tools	Faculty of Education and Social Work

Oral abstracts

ARTS

Global variation in innovation and economic complexity: insights from evolutionary science

Severi Luoto | *English, Drama and Writing Studies*

Evolution explains biological diversity through adaptation to environmental conditions. Human cultural evolution has enabled the near-global spread of our species, unprecedented population growth, and an order-of-magnitude increase in cultural innovations. All of these outcomes shape the way in which natural selection and sexual selection operate in modern humans. Yet not all countries have equal levels of innovation, population density, and economic production. With a dataset comprising 122 nations, I explore the way in which ecological and demographic variables predict global variation in economic complexity. Economic complexity ranks countries according to the level of diversification of their export baskets, thus reflecting the existing innovative knowledge and industrial composition of a society. The results of this research are in line with predictions arising from evolutionary theory: economic complexity is higher in countries with colder winters, an effect mediated almost completely by intelligence. Economic complexity is also significantly constrained by population-level adolescent fertility rates, showing the expected tradeoff between early reproduction and investment into economic development and innovation. Finally, population density is another demographic variable that significantly predicts global variation in economic complexity. These results remain robust even after controlling for per capita GDP, population size, and trade distance from Europe. This research sheds light on the ways in which evolutionary processes shape human adaptation to local environments. The current results indicate that these adaptive processes occur both at the level of psychological traits (intelligence, innovative capacity) and actual realised behaviours, indexed by global variation in reproductive timing, innovation, and economic complexity.

How do we communicate science in museums in Aotearoa?

Scott Pilkington | *Museums and Cultural Heritage*

On 2nd September 2018 the National Museum of Brazil in Rio de Janeiro, the oldest scientific institution in the country went up in flames. 90% of its 20 million collection items were lost. Critics attribute the destruction to funding cuts. It had just turned 200 years old. 6 weeks earlier, news had broken that Museum of New Zealand Te Papa Tongarewa, was seeking to cut 25 collection management staff in a cost cutting measure. It had just had its 20th birthday. Why should we care? What has been lost, and why does it matter?

Museums are not just knowledge-producing and collection-keeping institutions, they have to also be knowledge-transmitting vehicles. Museums can provide excellent learning environments for engaging with people about complex societal issues of our time (e.g. climate change, institutional racism, suffrage and sexism) by fostering thought and discussion about visitors' own behaviours. Museums provide a unique learning opportunity that can extend people's science literacy beyond the limits of their compulsory schooling. Science literacy is important for adapting to, and understanding modern society. However, most people only undergo science learning during compulsory schooling. Lifelong learning is critical for maintaining science literacy but opportunities for adults are hard to come by. Physical access to information aside, many adults may lack the necessary knowledge or comprehension required to make sense of new information.

My research examines the ways in which museums communicate science by investigating the motivations and processes used by museum staff, and the impressions and responses by museum visitors. My case study is the Auckland Medical Museum Trusts' travelling exhibition Brave Hearts: The New Zealand Cardiac Story which examines the history of cardiac medicine in Aotearoa New Zealand. I'm interviewing the exhibition developers and museum visitors to test how the museum has influenced their perceptions of science literacy.

"But who do you say I am?" - Images of God and NZ-Pacific Mental Wellbeing

Therese Kiely | *Theology*

My research investigates the significance of Christianity for the spiritual and mental wellbeing of young Christian, multi-ethnic Pacific women. It focuses on this cohort's individual images of God, what influences these images of God and how these images can impact an individual's mental wellbeing. Roman Catholicism, mixed ethnic cultural backgrounds, family life and social media all intersect in discerning who God is for these young women and how they see themselves in the world. Using the Praxis Model and an Intersectionality hermeneutic, I aim to weave strands together and contribute to community suicide prevention strategies and church communities.

EDUCATION AND SOCIAL WORK

Factors that influence science and non-science option choices in Year 13 at New Zealand secondary schools: Students' voices

Su Mukund | *Education*

The Trends in International Mathematics and Science Study (TIMSS) report from 2015 indicates that for over 20 years there were some declines and no improvements in students taking Science Technology Engineering and Mathematics (STEM) subjects. Yet, this technologically advanced world is evolving more towards STEM jobs. While one would assume that students would choose disciplines, especially science and technology that provide stepping stones to careers, not all student decisions are based on career prospects. It is difficult to assign a single factor to such decision making. This study aims to understand the intrinsic and extrinsic factors that influence Year 13 students' decision making in taking science or dropping science in the final year of high school. The study aims to explore five salient factors that significantly influence decision making and have been commonly mentioned in the literature. These include interest in science, external influences, experiences in the science classroom, science self-concept and career motivation. The study follows a Sequential Explanatory design using a mixed-methods approach. Data was gathered from a 25 items survey administered to all participating Year 13 students, both science and non-science followed by semi-structured interviews of 5 students taking one or more subjects in science and 5 students not taking science in Year 13. A quantitative approach examined the outcome of the survey results. A thematic coding analysis was applied to the data set gathered from the semi-structured interviews. The Qualitative phases included familiarization with the data set, generating initial codes, searching for themes among these codes, defining and naming the themes, and then producing a final report. Currently the findings are being analysed to see if there is evidence from the qualitative data to substantiate and explain the initial findings from the Quantitative data.

A narrative inquiry of beginning teachers' meaning-making of their work as a teacher

Fang Li | *Learning, Development and Professional Practice*

The first year of teaching significantly influences teachers' ongoing development and career trajectories. While much research has focused on beginning teacher induction and mentoring, less attention has been paid to beginning teachers' voices and perspectives on how they make meaning of their work as a teacher and the subsequent influence on their career aspiration.

Using Kelchtermans' (2009) narrative-biographical approach as the conceptual framework, this study explored how beginning teachers constructed, deconstructed, and reconstructed meaning from their first-year experience of working as a teacher. Narrative inquiry (Clandinin, 2007), as a key approach to understanding people's lived experiences, was utilised to collect and analyse the data. The findings suggest that the (mis)alignment of professional and personal selves have greatly influenced the participants' sense of becoming and belonging in the teaching profession. The study points to ways in which beginning teachers' integration of their professional and personal selves could be better supported.

An ecology for learning: Providing teachers with the right tools

Robin Lane | *Curriculum and Pedagogy*

In spite of the hard work of countless teachers and parents, many students are not able to take up learning opportunities in school. There are many reasons for this but teachers can only affect those that are related to their teaching practice. Teachers' time and energy are limited, and their access to the literature is limited, however a great deal of research (e.g. cognitive neuroscience and psychology, and educational sociology and philosophy) has been done in the past two decades that shines new light on effective teaching.

To bring this wealth of knowledge to teachers in a way that they can easily understand and access, my research has gathered generally accepted principles behind learning and practices of teaching, and organised them into an ecological structure. An ecological meta-theory celebrates all learning theories for the parts of learning they apply to, and interrelates them in a holistic framework so that teachers can choose useful ideas without being blinkered by narrow beliefs.

I asked teachers how they would prefer to be given the information, and created a database and website as a result. Each principle or practice is expanded ecologically to show how it applies to the learner, their immediate environment, and their wider environment. Possible interactions between the levels are offered and suggestions made for effective teaching and learning. Resources, links and further details are also given.

This resource informs everyday lesson planning and can also justify interventions for challenged learners by prompting teachers to examine their ideas and beliefs. It is easily searchable and intuitively organised. Teachers have shown great enthusiasm for this unique resource, and it only takes a short period of instruction for them to own the format and information, and to apply it readily to their teaching and learning environment.

Emotional triggers in thesis proposal writing: Chinese doctoral students' intercultural experiences

Linda Yu | *Centre for Learning and Research in Higher Education*

Doctoral students' writing emotions can have profound effects on their thesis-writing journey and academic achievement at university. Despite increasing attention to the affective domain of doctoral students' writing, little research has been conducted to investigate the writing emotions of Asian international doctoral students and especially their emotional triggers in thesis writing during their intercultural experiences. This exploratory study seeks to fill the gap, with a focus on Chinese doctoral students who are studying in an English-speaking country for the first time, and their emotions fully associated with proposal writing, during the first year of doctoral candidature in a New Zealand research-focused university. By using sequential mixed research methods, I collected the data through online surveys (n=73), and then by follow-up semi-structured interviews (n=23). Informed by Cognitive Appraisal theory (Roseman, 1996), in this paper, I report a range of writing-related emotions in both positive and negative dimensions by applying descriptive statistical analysis, and then I identify the writing-related triggers (stimuli) and surveyed respondents' appraisals of the most three experienced emotions in each dimension based on their open-ended responses. The results of this study have practical implications for intercultural doctoral writing supervision pedagogy and student-centred writing activity, which can in turn influence students' writing behaviour and lead to improved academic outcomes.

ENGINEERING

Nano-containers for signals to cells - when and where they are needed

Isabela Monteiro | *Chemical and Materials Engineering*

The ability of stem cells to either self-renew or differentiate towards different cell types under certain conditions makes them pivotal in applications of tissue engineering and regenerative medicine. In vivo, stem cells are tightly regulated in space and time by the cell microenvironment through key components and interactions such as growth factors (GFs), cell-cell contacts, and cell-matrix adhesions. Nevertheless, the insufficient control over cell fate and lack of understanding of stem cell behaviour in vitro continues to be a major research challenge. Studies have reported synergistic and inhibitory effects between integrin mechanoreceptors and growth factor signalling pathway. However, there is currently a lack of experimental techniques to study these synergistic effects and their implication on cell behaviour. In this special session I will creatively demonstrate in a performance how my PhD addresses those problems by the development of a novel platform for cell controlled GF delivery. In the platform proposed, self-assembling block copolymers are used to create a thin nanopatterned polymer layer in which active signalling molecules can be incorporated. The addition of a biodegradable layer on top of the polymer layer allows for the controlled release of the protein cargo. This technique will allow the local delivery of signalling molecules from the interface when cells have adhered and have started breaking down the capping layer, ensuring GF delivery in close proximity to cell adhesions, when and where they are needed. The configuration described above mimics the in vivo release of GFs from the extra cellular matrix occurring at the cell adhesion points. By mimicking vital parts of the in vivo environment, synergies between cell adhesion and GF signalling will be studied in vitro to better understand the effects of nano and molecular scale features on stem cell behaviour.

The Mountain that Walks

Marina Drazba | *Civil and Environmental Engineering*

When we think of hazards we often associate them with disasters and events that have already transpired. Even though it is hard to predict a natural hazard like a landslide, there are some measures that can be taken to mitigate against them. Landslides affect a large area and have the power to remove homes from their foundations and irrevocably change the terrain. They are initiated both through natural events like heavy rain as well as anthropogenic triggers. With the increasing mobility of populations into previously uninhabited areas there is a disconnect between land usage and understanding of land processes, especially in marginalized communities. Some communities have been living with landslide risks all their lives, but they may not know how to deal with the problem effectually. In some cases, the communities at risk are aware of the problems they face although they may not know how to mitigate against them, more than likely the population do not know their risks. We analyzed how we communicate technical information to the population at large and came up with a landslide book and play. The key information is distilled into key points: warning signs of landslides and slope disturbances, mechanisms of failure through water and slope loading, and mitigation by looking at slope shape and deforestation practices. The researchers needed the population to recognize their own risks and through community-based learning, the red flags of landslides such as tensions cracks are pointed out. Once the community understands what they are looking at, the mechanisms of landslides are discussed to help them reduce their exposure to the risk building their resilience. With a large population living in a dense environment, landslide awareness within the community is paramount to keeping them safe and cutting down the reaction time to warning signs is crucial.

Towards Practical and Ethical Video Analytics Systems

Andrew Chen | *Electrical and Computer Engineering*

Video analytics is the field of automatically processing camera footage in order to extract high-level insights about that footage. For example, we might use video analytics on security camera footage to detect unknown intruders in an office building.As artificial intelligence and computer vision techniques continue to improve, a wider range of applications are enabled. However, most computer vision research has only focused on accuracy, with little regard to speed. Many algorithms are prohibitively slow for real-world implementation.

In my thesis, I present the implementation of a multi-target multi-camera tracking system, which detects people and tracks their movements within a physical space in real-time. This targets commercial applications, such as understanding how shoppers move around a supermarket in order to better optimise supermarket layouts. This involves the development of a modular image processing pipeline, with each stage optimised for speed while balancing accuracy. This included the development of three novel algorithms designed to be computationally light.

In addition to this technical work, research was done into protecting the privacy of individuals being observed by these camera systems. The research advocates for a privacy-by-design approach, where privacy is "baked in" to the system so that privacy is respected by default. This involves the use of a privacy-affirming architecture, where smart cameras are used to complete the initial stages of the image processing pipeline, such that the video footage can be deleted at the point of image capture and never transmitted to any other computer.

Overall, this thesis presents the development of a video analytics system that is practical, in the sense that it is able to run in real-time on embedded computers with constrained resources, and is ethical, in the sense that the system is designed to protect the privacy of people being observed.

ECoS for Smart Homes

Latha Karthigaa Murugesan | *Electrical and Computer Engineering*

One of the most efficient ways of reducing household energy consumption, from a software engineering perspective, is through providing feedback to users on their energy consumption (energy feedback). Energy saving recommendations, visualisation of energy consumption and control of the appliances are some of the widely considered means to help end-users to conserve energy. Firstly, the existing literature and commercial solutions provide recommendations based on either usage patterns or context-aware data, but do not take into account user constraints and user preferences, and are limited only to basic recommendations. Secondly, different research solutions on visualisation provide aggregated & disaggregated energy consumption, near-real-time power data, and energy prediction, but not the location of the energy consuming appliances along with the energy consumption and appliance status. Moreover, the recommendations are limited to notifications and are not rendered within the visualisation for effective and immediate decision making by the end-users. Thirdly, the current research on control does not include controlling the appliances based on the recommendations and user preferences, such as timing constraints and targeted energy consumption. Finally, there exists no single system which integrates these three aspects; recommendation, visualisation, and control.

We have designed and implemented a web application called ECoS (Energy Control System), a simulation model using a combination of user-centred technologies, such as survey and design thinking activity. The features of ECoS are: (i) recommendation engine - that provides recommendations to the end-users based on energy usage patterns, context-aware data, users' energy constraints, and user preferences; (ii) visualisation engine - that visualises household electricity consumption with exact location of where the energy is being consumed, along with the recommendations and control features; and (iii) control engine - that enables users to control and schedule their household appliances based on the recommendations and

user settings through visualisation. The ECoS integrates the visualisation, recommendation, and control engines, and is evaluated by usability testing and quantitative experiments. An average of 21.61% household energy savings has been observed when tested on datasets of four countries. As a result, ECoS comprises of an optimal set of features based on user preferences, energy savings, and frequency of feedback, and it is hoped that ECoS would serve as a promising application for saving household electricity.

MEDICAL AND HEALTH SCIENCES

Dextrose gel for prevention of neonatal hypoglycaemia may improve motor, language, and executive function in two-year-olds

Rebecca Griffith | *Department of Paediatrics*

Neonatal hypoglycaemia can cause neurodevelopmental impairment. Dextrose gel prophylaxis reduces the incidence of hypoglycaemia, but neurodevelopmental effects are unknown. To determine whether dextrose gel prophylaxis in babies at risk of neonatal hypoglycaemia alters neurodevelopment at 2 years.

Prospective follow up study of children born at risk of hypoglycaemia, randomised to one of four dose regimes of prophylactic 40% dextrose gel or equi-volume placebo (pre-hPOD trial). The primary outcome was neurosensory impairment (blind; deaf; cerebral palsy; Bayley III cognitive, language or motor scores below -1SD). Secondary outcomes included components of neurosensory impairment and executive function.

360/401 (90%) eligible children were assessed. Hypoglycaemia was less common in the dextrose group (101/243 [41.6%] vs 63/117 [53.9%], relative risk (RR) [95% CI] 0.77 [0.62-0.97], p=0.02). The rate of neurosensory impairment (67/360 [19%]) was similar in dextrose and placebo groups (41/243 [16.9%] versus 26/117 [22.2%], RR 0.77 [0.50-1.19], p=0.23). Children in the dextrose group, compared with the placebo group, had higher Bayley motor scores (mean difference (MD) [95% CI] 2.70 [0.04 to 5.37], p=0.05), higher language scores (MD 3.53 [-0.14 to 7.19], p=0.06) and lower rates of low executive function (5.4% vs 11.3%, RR 0.48 [0.23-0.99], p=0.05). These differences were minimally attenuated after adjustment for recruitment centre, gestation, sex and socioeconomic status (motor score MD 2.51 [-0.12 to 5.14], p=0.06, language score MD 3.32 [-0.17 to 6.81], p=0.06, low executive function RR 0.50 [0.24-1.06], p=0.07). Dextrose gel prophylaxis may improve motor, language, and executive function at 2 years of age.

Characterising the vascular changes in the Alzheimer's disease human brain using tissue microarrays

Micah Daniel Austria | *Department of Anatomy with Medical Imaging*

The ability of stem cells to either self-renew or differentiate towards different cell types under certain conditions makes them pivotal in applications of tissue engineering and regenerative medicine. In vivo, stem cells are tightly regulated in space and time by the cell microenvironment through key components and interactions such as growth factors (GFs), cell-cell contacts, and cell-matrix adhesions. Nevertheless, the insufficient control over cell fate and lack of understanding of stem cell behaviour in vitro continues to be a major research challenge. Studies have reported synergistic and inhibitory effects between integrin mechanoreceptors and growth factor signalling pathway. However, there is currently a lack of experimental techniques to study these synergistic effects and their implication on cell behaviour. I will demonstrate how my PhD addresses those problems by the development of a novel platform for cell controlled GF delivery. In the platform proposed, self-assembling block copolymers are used to create a thin nanopatterned polymer layer in which active signalling molecules can be incorporated. The addition of a biodegradable layer on top of the polymer layer allows for the controlled release of the protein cargo. This technique will allow the local delivery of signalling molecules from the interface when cells have adhered and have started breaking down the capping layer, ensuring GF delivery in close proximity to cell adhesions, when and where they are needed. The configuration described above mimics the in vivo release of GFs from the extra cellular matrix occurring at the cell adhesion points. By mimicking vital parts of the in vivo environment, synergies between cell adhesion and GF signalling will be studied in vitro to better understand the effects of nano and molecular scale features on stem cell behaviour.

To Wnt5b or not to Wnt5b: Understanding the role of Wnt5b in lymphatic specification

Grace Borichevsky | *Department of Molecular Medicine and Pathology*

Lymphatic vessels are essential to maintaining fluid homeostasis, fat transport, and immune function. Lymphatic endothelial cells originate from veins, however, despite their importance the mechanisms that enable a subset of venous cells to become lymphatic precursors are largely unknown. Recent research using zebrafish indicates that the Wnt/-catenin pathway might influence lymphatic fate in the veins. In the zebrafish trunk lymphatics Wnt5b induces lymphatic precursors, while in the facial lymphatics it appears to inhibit lymphatic fate. This project seeks to understand the role of Wnt signalling during lymphatic specification.

The aim of this study is to examine how Wnt5b acts to regulate lymphatic fate in the zebrafish facial lymphatics. Using translation and splice blocking morpholinos Wnt5b was knocked down in transgenic zebrafish which have fluorescently labelled veins and lymphatic vessels. The length of the developing facial lymphatic sprout and the number of lymphatic precursors was compared between controls and Wnt5b knockdown embryos.

Wnt5b knock down causes an increase in the number of lymphatic precursors in facial veins, but inhibited the developing facial lymphatics. Wnt5b appears to act to negatively regulate lymphatic fate in the facial lymphatics, but lymphatic vessel growth appears to be restrained by yet unidentified factors. Future work will investigate mutants and inhibitory factors in the Wnt/-catenin signalling pathway to understand how Wnt signalling acts influence lymphatic fate and development.

PilVax: a novel peptide carrier for the development of vaccines against tuberculosis

Sam Blanchett | *Department of Molecular Medicine and Pathology*

PilVax is a peptide delivery strategy for the generation of highly specific mucosal immune responses. The food-grade bacterium Lactococcus lactis is used to express selected peptides engineered within the Group A Streptococcal pilus, allowing for peptide amplification, stabilisation, and enhanced immunogenicity.

The present study aims to demonstrate the suitability of PilVax for the generation of novel peptide vaccines against tuberculosis. Selected peptides (B cell and T cell epitopes), derived from tuberculosis vaccine targets ESAT6 and Ag85B, were genetically engineered into loop regions of the pilus backbone subunit and expressed in L. lactis. Western blots and flow cytometry confirmed pilus formation on L. lactis. Mice were vaccinated with these constructs and T cell response analysed by flow cytometry.

A significant number of Ag85B peptide-specific CD4+ T cells were detected when mice were immunised intranasally with a PilVax Ag85B-peptide construct, at levels similar to when mice were immunised with Bacillus Calmette–Guérin (BCG) vaccine. However no CD4+ T cells specific for ESAT6 peptides were detected. This is despite a significant amount of IL-2 and TNF-a being detected in lung T cells from mice immunised with a PilVax ESAT6 peptide construct following stimulation with cognate peptide. These results confirm at least one PilVax construct is able to elicit a similar CD4+ T cell response to a BCG vaccination, which will be tested further for protection. We are currently also testing the antibody response to PilVax constructs expressing the Ag85B and ESAT6 peptides.

Development of a mucosal vaccine candidate for Staphylococcus aureus using the novel carrier PilVax

Kelly Peterken | *Department of Molecular Medicine and Pathology*

Staphylococcus aureus is an opportunistic human pathogen that causes a range of diseases. Rising antibiotic resistance in this organism has caused a decline in treatment options, and currently no vaccine is available. PilVax is a novel vaccine carrier which uses a *Lactococcus lactis* strain engineered to express copies of pili and selected peptides on its surface. We selected two peptides (D1 and D3) from Fibronectin binding protein to be inserted into PilVax to elicit a mucosal immune response to *S. aureus*.

The aim of this study is to determine if selected *S. aureus* peptide antigens expressed on PilVax can elicit a mucosal immune response in mice. Expression of the pilus structure and candidate peptides was confirmed via flow cytometry and western blotting. Female BALB/c mice were immunized intranasally with two different *L. lactis* strains expressing candidate peptides. Peptide-specific antibody responses in stool, serum, lung or small intestine were measured by enzyme-linked immunosorbent assay (ELISA). Lymphocyte responses in the spleen and draining lymph nodes were examined via ELISpot, and the cytokine profile determined by intracellular cytokine staining.

Flow cytometry and western blotting confirmed that selected strains expressed pili. A strong mucosal antibody response against the pilus was present in groups vaccinated with the PilVax construct. Immunisation with the D3 peptide, but not the D1 peptide, stimulated a mucosal antibody response. We have demonstrated that an S. aureus peptide can be engineered into PilVax and stimulates a robust mucosal antibody response. Further studies will focus on whether the vaccine affects *S. aureus* colonisation.

Functional Analysis of Streptococcus Virulence Factors using a Zebrafish Infection Model

Kar Yan Soh | *Department of Molecular Medicine and Pathology*

Streptococcus pyogenes (Group A Streptococcus, GAS) causes a variety of diseases in humans ranging from pharyngitis and impetigo to more severe invasive diseases including cellulitis, necrotising fasciitis and toxic shock. Investigations of GAS pathomechanisms are hindered by the lack of suitable animal infection models.

The aim of this study is to characterise two important GAS virulence factors, *Streptococcus pyogenes* nuclease A (SpnA) and streptococcal 5'-nucleotidase A (S5nA), by investigating the orthologues SpnAi and S5nAi in the fish pathogen *Streptococcus iniae* using a zebrafish infection model. Methods: a) Biochemical analysis of recombinant SpnAi and rS5nAi; b) Deletion of *spnAi* and *s5nAi* genes in *S. iniae* by allelic replacement; c) Analysis of *S. iniae* wild-type and deletion mutants in zebrafish infection models.

rSpnAi is able to digest linear double-stranded DNA and chromosomal DNA with highest activity at pH 6.5–7.5 and between 32°C–37°C in the presence of Ca2+ and Mg2+. rS5nAi is able to generate immunomodulatory molecules adenosine and macrophage toxic deoxyadenosine with highest activity at pH 7 and 42°C in the presence of Mg2+. *S. iniae spnAi* and *s5nAi* gene deletion mutant have been generated by allelic replacement. Injection of wild-type *S. iniae* into hindbrain induced a lethal infection, while *S. iniae spnAi* and *s5nAi* gene deletion mutant shows greater than 80% survival at 24 h post-infection. Biochemical analysis of rSpnAi and rS5nAi showed that both proteins have very similar reaction conditions compared to SpnA and S5nA, respectively. Wild-type *S. iniae* but not *spnAi* and *s5nAi* gene deletion mutant impair survival of zebrafish larvae.

Investigating Tumour Evolution in a Single Patient with Disseminated Cancer

Tamsin Robb | *Department of Molecular Medicine and Pathology*

For cancer biologists, understanding the evolution and genomic heterogeneity of multiple tumours in a single patient is an important goal. For oncologists, genomic maps of multiple tumours in each patient could facilitate improved precision oncology; enabling selection of therapeutic targets universal to a patient's tumours, and private resistance mechanisms found in individual metastases.

A patient with a primary lung neuroendocrine tumour and 88 metastases requested and consented to a rapid autopsy, providing a rare opportunity to study tumour evolution and heterogeneity in a single patient. This multi-layered genomic investigation, augmenting clinical notes and imaging, produces a personalised evolutionary model of disease progression. Following comprehensive ethical consultation, the patient and her extended family provided informed consent to the collection of tumours through rapid autopsy, whereby 89 lesions were sampled extensively. From 30 tumour samples, differences across DNA whole exome sequencing and mRNA sequencing data were used to build statistical evolutionary phylogenetic models.

Overall, the tumours were generally homogenous in terms of single nucleotide variants (SNVs), indels and copy number variants, mirroring histopathological homogeneity. However, key differences in SNVs that may have driven metastatic events were noted and used to infer tumour lineages and evolutionary progression; indicating that multiple ancestral lineages within the primary tumour may have seeded different metastatic tumours. This analysis allows inferences to be made in the programme of evolutionary progression. This patient's generous donation represents an invaluable opportunity to investigate biological drivers of tumour evolution, important to cancer biologists and oncologists alike.

Generating immune-compatible sheep for xenotransplantation

Sarah Appleby | *Department of Molecular Medicine and Pathology*

Sheep have a similar physiology and anatomy to humans, making them a potential widely acceptable donor for organ transfer. However, one critical barrier to the use of organs from foreign species is immune rejection. Two main xenoantigens involved in immune reaction are galactose-α(1,3)-galactose (α-Gal) and N-glycolylneuraminic acid (Neu5Gc).

The aim of this study is to use gene editing to disrupt formation of xenoantigens α-Gal and Neu5Gc to generate sheep with lowered human immune response for xenotransplantation. CRISPR-Cas9 system was used to disrupt the enzymes responsible for forming α-Gal and Neu5Gc, α(1,3)galactosyl transferase (GGTA) and cytidine monophosphate-N-acetylneuraminic acid hydroxylase (CMAH), respectively, in ovine fetal fibroblasts. Editing efficiency was determined by molecular analysis of nucleotide insertions/deletions or antibody reactivity to xenoantigen. Clonal edited cell lines were isolated, genotyped, and screened for abnormalities. Serial somatic cell nuclear transfer (SCNT) was used with chosen cells and embryos transferred into ewes.

High editing efficiency was observed for both genes (GGTA=97±0%, CMAH=77±4%). 54 clonal lines were isolated with 11 different edited genotypes. Frameshift mutations were frequent for GGTA (73%) and CMAH (64%), with 55% of clones containing frameshifts for both genes. Two clones were used for SCNT, resulting in blastocyst development rate of 19±3% (89/476, n=12). At day 35, 23±6% of embryos (9/39, n=8) resulted in a viable pregnancy.

This editing system produced high efficiency frameshift mutations simultaneously in GGTA and CMAH. Clonal cell lines successfully produced blastocysts for transfer. Resulting lambs will be analysed to confirm loss of α-Gal and Neu5Gc and evaluated as donors for xenotransplantation.

Genetic Feto-Maternal Microchimerism

Matthew Kang | *Department of Obstetrics and Gynaecology*

Feto-maternal microchimerism is the permanent incorporation of fetal cells into the maternal body. Most studies demonstrate microchimerism by detection of cells containing a sex-determining region Y (SRY) gene. The

placenta, a fetal organ, sheds three types of extracellular vesicles (EVs), macro-, micro-, and nano-EVs into the maternal circulation. Placental EVs carry vast amounts of cell-free fetal DNA (cffDNA). It is possible that what researchers had been interpreting as chimeric fetal cells may have been maternal cells transfected by EV-borne cffDNA.

We hypothesised that different placental EVs carry different cffDNA profiles and are able to transfect maternal cells during pregnancy, creating genetic feto-maternal microchimerism. Macro-, micro-, and nano-EVs were separated from placental explant cultures by differential centrifugation. Following DNA extraction, cffDNA quantity and fragment sizes were determined by Qubit and TapeStation analyses. Whole-exome sequencing (WES) determined the genes present in EVs.

Different EVs contained different amounts of cffDNA when normalised to 1 gram of placenta: macro-EVs 98.9 ng, micro-EVs 246.6 ng, and nano-EVs 519.9 ng. The cffDNA fragment sizes were also different: macro-EVs showed single size (13000-30000 bp), micro- and nano-EVs contained cffDNA with large fragments (9000-12000 bp) and smaller fragments (400—1700 bp). WES showed that SRY was present in all EVs. Vast quantities of cffDNA are carried via placental EV and all placental EVs carried large DNA fragments, increasing the likelihood that whole fetal genes could be packaged. The presence of SRY in all placental fractions potentially reinforces genetic feto-maternal microchimerism.

Optimisation of Direct Cellular Reprogramming to Model Huntington's Disease

Ruth Monk | *Department of Pharmacology*

The study of neurodegenerative disorders, including Huntington's disease (HD), has been impaired by limited access to live human disease-affected neurons. Cellular reprogramming of patient-derived somatic cells offers an opportunity to generate live human neurons for the study of disease pathology and mechanisms.

This study aimed to optimise the generation of DARPP32+ striatal neurons using induced neural precursor cells (iNPs), and demonstrate the capability to reprogram HD patient-derived fibroblasts. We used our recently developed protocol to directly reprogram fibroblasts into iNPs via co-transfection of chemically-modified-mRNA encoding the pro-neural transcription factors SOX2 and PAX6 in a specialised reprogramming medium. Successive optimisation studies were performed investigating the use of small molecules, hypoxic (5% O2) conditions, and BrainPhysTM medium to enhance the generation of functional DARPP32+ neurons. We used this optimised protocol to reprogram fibroblasts from HD patients (nCAG 41-57) into iNPs and DARPP32+ neurons.

Directly reprogrammed iNPs expressed early neural markers SOX2, PAX6, NESTIN, NGN2, and early striatal markers GSX2, ASCL1, DLX2, and MEIS2. Differentiating iNPs expressed ion channel genes (CACNA1C, SCN8A) and synaptic genes (SNAP25, SAP97, PSD95). After 30 days of differentiation, high yields of striatal neurons (>30% TUJ1+/DAPI+; >90% DARPP32+/TUJ1+) were generated and produced electrophysiological activity. The combination of BrainPhysTM and hypoxia further increased neuron yields to >40% TUJ1+/DAPI+ by day 58 of differentiation. This study generated an optimised protocol capable of efficiently reprogramming and differentiating HD patient-derived fibroblasts, thus providing an effective model for future research into HD pathology and mechanisms.

Effect of glucose and fructose exposure on cardiomyocyte glycogen handling

Marco Annandale | *Department of Physiology*

Diabetic cardiomyopathy is characterised by changes in metabolic processes, linked with impaired glucose signalling and increased glycogen storage. Emerging evidence suggests that cardiac fructose levels are elevated but whether cardiac fructose exposure similarly elicits a glycogen response is unknown.

The aim of this study was to investigate the effects of high glucose and fructose exposure on cardiomyocyte glycogen levels. Neonatal rat ventricular myocytes (NRVMs) were isolated from 1-2 day old Sprague Dawley rats. NRVMs were treated with high glucose (30mM) or fructose (1μM to 1mM range) for 24 hours prior to lysing cells. In addition, human pluripotent stem cell derived cardiomyocytes (iPSC-CMs) were incubated in high glucose (25mM) media. Cardiac glycogen levels were measured using an amyloglucosidase enzymatic assay.

A 4.8 fold ($p<0.05$) increase in cardiac glycogen was observed in the human iPSC following 24 hours high glucose treatment. Likewise, glycogen significantly increased by 19% ($p<0.05$) in NRVM cells treated with high glucose media for 24 hours. In contrast, 24 hours of fructose exposure had no effect on NRVM cell glycogen levels. This study for the first time demonstrates that exposure to high glucose conditions in both human iPSC and NRVM recapitulates the increase in cardiac glycogen observed in diabetic patients and are viable models for testing the effects of cardiac glycogen accumulation on cardiac function. In contrast, no change in glycogen following acute 24 hour fructose exposure was observed. Longer exposure times and higher concentration of fructose may yield different effects and warrants further investigation.

Rewarming after therapeutic hypothermia for neonatal hypoxic-ischemic encephalopathy – is fast or slow rewarming better?

Anthony Davies | *Department of Physiology*

Therapeutic hypothermia partially reduces death and disability in neonatal hypoxic-ischemic encephalopathy. There is very limited evidence that slower rewarming may help optimize outcomes after treatment.

The aim of this study is to contrast neuroprotection after controlled slow rewarming with spontaneous rapid rewarming after 72 hours of hypothermia after global cerebral ischemia in the near-term fetal sheep. Chronically instrumented fetal sheep (0.85 gestation) were randomised to sham control (n=9), ischemia-normothermia (n=8), ischemia-72 h hypothermia-rapid-rewarming (n=8) and ischemia-72 h hypothermia-slow-rewarming over 10 h (n=9). Hypoxia-ischemia was induced by bilateral carotid artery occlusion for 30 minutes. Hypothermia was started 3 h post-hypoxia-ischemia.

Ischemia was associated with rapid suppression of electroencephalographic power compared to sham-control ($p<0.05$). Both hypothermia groups showed a similar improvement in electroencephalographic power from 24 h onward compared to ischemia-normothermia ($p<0.05$). Ischemia was associated with significant neuronal loss in the cortex and hippocampus and reduced expression of CNPase and myelin basic protein (MBP) in white matter ($p<0.05$). Both hypothermia protocols significantly improved neuronal survival in the cortex and CA3 ($p<0.05$), with a small but significantly greater survival in the cortex, CA4 and dentate gyrus after rapid rewarming compared with slow rewarming ($p<0.05$). Slow rewarming was associated with increased CNPase expression, while rapid rewarming better preserved MBP expression. Slow rewarming after 72 h of hypothermia did not improve recovery of brain activity or overall neuronal survival, and was associated with slightly less neuronal survival in some regions than rapid rewarming. The effects of rewarming on white matter injury was mixed, and the impact on brain development is unclear.

Impact of media coverage on venlafaxine-reported side effects following a nation-wide drug switch

Kate Mackrill | *Department of Psychological Medicine*

Over the course of 2017, patients taking both a branded and generic venlafaxine anti-depressant were switched to a new generic formulation (Enlafax). On February 28 2018, two major New Zealand media outlets ran stories about the new generic being less effective and causing specific side effects like fatigue, nausea and suicidal thoughts.

The aim of this study is to examine the effect of the media coverage on venlafaxine side effects reported to the Centre for Adverse Reactions Monitoring (CARM) and whether the symptoms reported in the media stories

increased compared to other side effects not reported in the media. The study analysed monthly adverse reaction reports for Enlafax to CARM from October-June 2018 and compared total adverse reports, complaints of decreased therapeutic effect and specific symptom reports before and after the media coverage.

Following the media stories, there was a significant increase in the number of side effects reported (pre-media monthly average = 7.00, March total = 65, p = .002) and complaints of reduced therapeutic effect (pre-media = 4.00, March = 24, p = .007). The reporting of specific side effects mentioned in the media coverage also increased, the largest being for suicidal thoughts (pre-media = 0.40, March = 8, p < .001). In the context of a drug switch, media coverage of side effects appear to cause a strong adverse response by increasing both the overall rate of side effect reporting and the specific side effects mentioned in the media coverage, including reduced drug efficacy and increased suicide ideation.

Using an Active Visualisation device to improve adherence to antiretroviral therapy in South Africa

Annie Jones | *Psychological Medicine*

Non-adherence remains the largest cause of treatment failure to antiretroviral therapy (ART) for patients living with HIV. Despite having the largest worldwide HIV pandemic, few successful adherence interventions have been conducted in South Africa. Active visualisation is a novel intervention approach that may help effectively communicate the need for consistent adherence to ART.

The current study aims to test the efficacy of an active visualisation intervention for improving adherence to antiretroviral therapy in South Africa, with non-adherent patients. 111 patients failing on first or second line ART were recruited from two sites in the Western Cape, South Africa. Participants were randomly allocated to receive the intervention or standard care (including adherence counselling). The primary outcome was adherence as measured by plasma viral load (VL).

There was a marginally significant and clinically significant difference (p= .06) in VL change scores between groups from baseline to follow-up, where the intervention had a greater decrease in log VL (Madj= -1.92, CI [-2.41, -1.43), as compared to the control group (Madj= -1.24, [-1.76, -0.73]). Participants in the intervention group were also significantly more likely to have a 0.5 log improvement in VL at follow-up ($\chi 2(1) = 4.82$, p = .028, $\Phi = 0.28$). This study provides initial evidence for the efficacy of this novel, brief intervention for improving adherence to ART in South Africa. This intervention has high clinical applicability and could be incorporated into standard clinical care as an adjunct to adherence counselling.

The Self-Phone: Impact of the mere presence of a mobile phone on patient satisfaction

Hemisha Priya | *Psychological Medicine*

Recent psychological research has found that the 'mere presence' of cell-phones can negatively impact perceptions of face-to-face communication and reduce conversation satisfaction. The current study aimed to explore whether this effect occurs in doctor-patient consultations, to reduce patient trust and satisfaction. Both the presence of a non-functioning anonymous cell-phone and the presence of the patient's own cell-phone were investigated.

104 patients attending their general practitioner (GP) consultation were randomised to two conditions: anonymous phone present (n=68) or absent condition (control group) (n=36). For the phone-present condition, the researcher placed an anonymous, non-functioning smartphone visible to the patient on the GP's desk. In the control condition, a notebook was placed in the same position. Trust and satisfaction was measured using a 7-point Likert questionnaire.

No differences were found between the anonymous phone-present and phone-absent conditions for patient trust (p =.452) or satisfaction (p =.944). However, participants who had their own cell-phone present during their consultation reported significantly greater satisfaction than patients who did not (p =.038).

These results suggest that the mere presence of an anonymous cell phone does not affect patient satisfaction. However, the patient's own cell-phone may act as a digital security blanket that makes them feel more comfortable during the consultation. Overall, the results from this study add to the limited literature on the 'mere presence effect'. The findings may give practitioners insight on whether they should have their own cell-phone visible to patients, or allow the presence of patient cell-phones during consultations.

Gut hormone and gut bacteria changes in patients with T2D undergoing SG or RYGB surgery

Naomi Davies | *School of Medicine*

Bariatric surgery is the only therapy with long-term weight reduction and dramatic effects on remission and prevention of type 2 diabetes (T2D) among those with severe obesity. The two most commonly performed procedures are Roux-en-Y gastric bypass (RYGB), and sleeve gastrectomy (SG). In order to develop novel medical treatments for obesity and T2D, it is vital to understand the mechanisms underlying the specific impacts of these surgeries.

The aim of this study is to examine the effects of RYGB and SG on the gut microbiota, and if these effects relate to other clinical data including glucose homeostasis, gut hormones, and body composition. Body composition data, oral glucose tolerance testing (OGTT) blood samples, and fecal samples were collected at baseline, and 1-year after surgery, from ~114 patients who were randomised to either RYGB or SG.

Diabetes remission (defined by HbA1c <48mmol/mol) was attained in 75% and 72% of participants undergoing RYGB and SG respectively (p=0.83). Preliminary analyses of the gut microbiota have identified a trend towards higher Desulfovibrio species at baseline in patients with persistent diabetes at 1 year, aligning with other reports focussing on the use of Desulfovibrio as a potential predictor of diabetes remission. This is the first study investigating the comparative effects of SG and RYGB on hormonal changes and gut microbiota among patients with T2D. While early caloric restriction due to volume restriction is important, there are likely additional mechanisms by which these types of surgery impact metabolism independently, specifically, alterations in gut hormones and the gut microbiota.

LIGGINS INSTITUTE

Comprehensive profiling of the circulatory miRNAome response to a high protein diet in elderly men

Farha Ramzan | *Liggins Institute*

MicroRNAs (miRNAs) are critical to the coordinated posttranscriptional regulation of gene expression, yet few studies have addressed the influence of habitual diet on miRNA expression. High protein diets impact cardio-metabolic health and body composition in the elderly, suggesting the possibility of a complex systems response, potentially partly mediated by miRNAs.

The aim of this study is to quantify and characterize the expression of alterations in the circulatory miRNAome in response to doubling the recommended dietary allowance (RDA) of protein for 10 weeks in older men. Thirty-one older men (74.1 ± 0.6 y) were randomized to consume either the RDA (0.8 g/kg/day) or twice the RDA (2RDA; 1.6g/kg/day) of protein for 10 weeks. Profiling of circulatory miRNAome were performed using high throughput small RNA sequencing, followed by In silico functional analysis of targets genes.

Downregulated expression of five miRNAs (miR-125b-5p,-100-5p,-99a-5p,-23b-3p &-203a) was observed following the 2RDA diet, with no changes in the RDA group. In silico functional analysis demonstrated gene enrichment in inflammation-related pathways. To examine this further, expression of

predicted inflammatory genes (TNF-α, IL-8, IL-6, pTEN, PPP1CB & HOXA1) was quantified in peripheral blood mononuclear cells (PBMCs) by RT-qPCR. All target genes were increased ($p \leq 0.05$) by the 2RDA diet. A small subset of miRNAs, implicated in the regulation of inflammation, showed downregulated expression following the consumption of 2RDA diet. This was supported by a corresponding increased abundance of pro-inflammatory genes in circulating PBMCs, suggesting a possible selective alteration in some aspects of the immune system following a high protein diet.

The effect of a high protein diet on gut metabolites: a randomised controlled trial

Sarah Mitchell | *Liggins Institute*

Diet exerts a major influence on the composition and metabolic output of the distal gut microbiota. Increasing dietary protein over the recommended intake has been proposed for the elderly, however excess protein in the distal gut can lead to production of volatile organic compounds (VOCs) likely to be detrimental to gut health such as amines, sulphides, and phenols.

The aim of this study is to establish if faecal VOCs indicative of protein fermentation are increased in healthy elderly males after consuming a high-fibre high protein diet (HPD) compared to a high-fibre recommended protein diet (RPD). Twenty-nine healthy men (74.2 ± 3.6 years) were randomised to consume a controlled HPD (1.6g/kg/day) or RPD (0.8g/kg/day) for 10 weeks. Faecal samples were collected at baseline and week 10. Headspace solid-phase micro-extraction gas chromatography mass spectrometry (H-SPME-GC-MS) was used to identify faecal VOCs. The faecal microbiota was characterised by 16S rDNA gene sequencing using the Ion Torrent platform, and a correlation analysis between microbiota species and VOCs was performed.

A total of 302 VOCs were identified. No VOCs differed between groups. Several bacterial genera were significantly correlated with higher peak intensities of butyrate and related derivatives. Across all subjects, protein and carbohydrate intake were each positively and negatively correlated with indole concentrations, respectively. Higher protein intake coupled with high fibre did not elevate VOCs linked to protein fermentation, which may reflect competitive microbial substrate metabolism of fibre. The interaction of nutrient substrates on microbial metabolite production requires further investigation.

The role of IL-1 signaling in female fertility and reproductive health

Pania Bridge-Comer | *Liggins Institute*

Obesity and its related morbidities pose significant health risks and are strongly associated with persistent low-grade inflammation. IL-1R1, a key pro-inflammatory mediator, bridges reproductive, metabolic, and inflammatory systems. IL-1R1 knockout (IL-1R1-/-) offers protection against high-fat diet (HFD)-induced metabolic dysfunction in young male mice. However, the role of IL-1R1-/- has not been investigated in female mice.

The aim of this study is to determine whether IL-1R1-/- has beneficial effects on metabolic and reproductive function in female mice and their offspring. Female C57BL/6 (control) and IL-1R1-/- mice were randomly assigned to a control diet (10%kcal from fat) or HFD (45%kcal from fat). Virgin (8 weeks on diet), pregnant (1 week prior to and throughout pregnancy) and post-weaning (6 weeks post-weaning) studies were used to examine ovarian gene expression, pregnancy success, time to first litter and insulin and leptin concentrations.

HFD induced glucose intolerance, hyperinsulinaemia, and hyperleptinaemia irrespective of genotype. Virgin IL-1R1-/- mice had increased ovarian Foxo3a, Gdf-9 and Bmp-15 expression compared to C57BL/6 mice. Post-weaning IL-1R1-/- mothers had increased ovarian Foxo3a, Pgr and Fshr expression. IL-1R1-/-HFD mice had a significant reduction in pregnancy success and increased time to first litter. Furthermore, offspring from both IL-1R1-/- and HFD mothers entered puberty significantly earlier than control and had increased fat mass by adulthood. IL-1R1-/- in female mice does not offer the same protection against HFD-induced metabolic dysfunction as seen in young male mice in previous studies. Furthermore, inhibition of IL-1R1 signalling alters ovarian function, reduces fertility and exacerbates glucose intolerance in response to HFD.

Ten Eleven Translocation Enzymes Exhibit Cell-Specific Differential Expression in Response to Steroid Hormones in Human Endometrium

Vishakha Mahajan | *Liggins Institute*

DNA methylation and the recently discovered hydroxymethylation are two epigenetic modifications that influence gene expression through contrasting functions. Mediated by three Ten Eleven Translocation (TET) enzymes, 5-hydroxymethylation (5hmc), is a critical factor regulating human development. Abnormal establishment of methylation patterns have been implicated in several endometrial diseases. However, the exact role of hydroxymethylation in the endometrium is yet to be explored.

The aim of this study is to characterise TET1, 2 and 3 expression across the menstrual cycle and further, to determine the effect of steroid hormones on epithelial and stromal cells independently. Endometrial tissue biopsies were previously collected from healthy, reproductive-aged women at different stages of menstrual cycle. To understand cell-specific expression, Epithelial (HES) and stromal (HESC) cells from 3 samples were treated with either control, estradiol, progesterone or a combination of both. TET gene expression was determined using real-time PCR.

TET1 and TET3 mRNA expressions in the mid-secretory phase were significantly up-regulated compared to proliferative phase and the early-secretory phase. Subsequently, TET1 and TET3 mRNA expressions were down-regulated in the late and early-secretory phases, respectively. Differential mRNA expression of TETs was seen with TET1, 2 and 3 being down-regulated and TET3 being up-regulated in response to 48 hours of progesterone treatment in HESC and HES cells correspondingly. Our data imply that TETs are dynamically expressed in the endometrium during the menstrual cycle and are regulated in a cell-specific manner by steroid hormones. Further studies are underway to explore the relationship between DNA methylation and hydroxymethylation and to characterise their role in endometrial biology.

SCIENCE

The Role of the PACAP Receptor Extracellular Domain in Receptor Activation and Signalling

Georgia Watson | *School of Biological Sciences*

Migraine is a common and debilitating neurological condition. Migraine attacks are associated with severe pain, among other debilitating symptoms. As current migraine drugs have limited effectiveness in some patients, and are associated with a wide range of side effects, it is critical that new therapeutics are developed.

The neuropeptide PACAP (Pituitary Adenylate Cyclase Activating Polypeptide) activates PAC1 (PACAP type I receptor) during the onset of a migraine attack. As such, blocking PAC1 activation may prevent migraine attacks. Evidence from structural and computational modelling studies of a PAC1 splice variant have suggested a number of key amino acids in the extracellular domain (ECD) important for binding. However, these interactions have not been studied, and it remains unknown which interactions are important for signalling.

This project aims to determine the importance of amino acid residues in the PAC1 ECD for receptor activation and signalling. To do so, a homology model of related receptors has been used to identify potentially important residues. Targeted alanine mutagenesis has then been performed, and the effect on receptor activation measured. Initial results suggest the computational models are not accurate for the full length receptor. This research will help define the activation mechanism of PAC1 receptor activation, and determine key residues to be targeted in future drug development studies.

Plasmin system proteins regulate endothelial presentation of CCL21 and subsequent T cell extravasation

James Hucklesby | *School of Biological Sciences*

T cells are a specialist component of the immune system, responsible for detecting bacteria, viruses and cancers within the body and triggering a retaliatory response. To do this, T cells must be able to patrol all of the body's tissues, which they achieve by hitching a ride in the blood. Cells roll along the inner surface of the blood vessels (endothelium) sampling a range of proteins whilst searching for an appropriate exit point. Once this is detected cells stop (arrest) and exit from the blood vessel in a process termed extravasation. One key factor that regulates this process is CCL21, however an effective mechanism for the removal of this protein has not yet been described.

This research explores a role for the vascular protease plasmin, traditionally described as a protein involved in the dissolution of blood clots, in regulating CCL21 at the endothelial surface. Furthermore, we explore whether this difference can control T cell extravasation in an in-vitro model.

A human cell line (HMEC-1) was established as a serum-free endothelial model. Plasmin's presence at the surface of HMEC-1 cells was measured using a fluorescent substrate, and ELISA used to quantify CCL21 release. Finally, live cell imaging was used to visualise attachment of primary human T cells to HMEC-1 under flow conditions.

HMEC-1 cells can efficiently bind plasminogen, activating it to plasmin when treated with exogenous tissue plasminogen activator. This plasmin could effectively remove CCL21 from HMEC-1 cells. Finally, live cell imaging demonstrated that this mechanism could modulate the interactions with T cells under flow.

This research demonstrates for the first time that the plasmin localised to a model human endothelial surface can regulate CCL21 presentation, and hence modulate the quantity of T cells undergoing arrest. The overall regulation of this system may have important implications for modulating immune responses, potentially allowing better therapeutic outcomes from inflammatory disease.

CpG for ID: Forensic applications of DNA methylation analysis

Rebecca Richards | *School of Chemical Sciences*

Analysis of DNA methylation displays considerable promise in a variety of forensic applications including chronological age estimation and identical twin differentiation. Knowledge of the age of a body fluid donor would offer intelligence information to investigators, as well as provide context to physical characteristic markers such as those for hair colour. Differentiation of identical twins would also be of considerable benefit as identical siblings cannot be distinguished using existing techniques when a correspondence between profiles recovered from crime scene samples and a person is identified. This research aims to assess the use of DNA methylation markers (CpG sites) for these forensic applications, as well as to validate a methodology that could be implemented into forensic casework. In a proof of concept study, buccal swabs of 5 identical twin pairs were analysed together with whole blood (n=28) and semen (n=8) swabs from individuals aged 22-62 years. Over 100 CpG sites from 13 different genomic regions were examined. Preliminary results illustrate that the differentiation of identical twins and the development of age prediction models, with similar accuracies to international research, are both possible using a selection of the CpG sites tested. In addition, targeted multiplexing of bisulfite converted DNA in combination with massively parallel sequencing has been demonstrated to be a viable alternative to traditional methylation analysis techniques. The need for further work testing the identified CpG sites of interest in a larger sample size and investigating their performance under a variety of forensic type circumstances is highlighted.

Derivatisation of flavonoids found in food waste to enhance bioactivity

Stephen Lo | *School of Chemical Sciences*

Flavonoids are a large class of secondary metabolites and phytochemicals found in plants, as well as fruits and vegetables. These compounds have become a great topic of interest due to the number of potential health promoting effects they can have in humans. Their immediate therapeutic effects, however, are significantly hindered by their low bioavailability.

Derivatisation of, or making slight chemical structural modifications to, these flavonoids is a viable strategy to circumvent this issue. This would, hopefully, alter the physicochemical properties of the compound to improve its bioavailability. The structure of flavonoids often contain multiple hydroxy sites, making them simple to modify. Since certain hydroxy sites of these compounds contribute to the desired health promoting activities, the derivatisation strategy also needs to consider keeping these key structural features and only modifying those that are less important.

Currently we have successfully produced a number of luteolin derivatives, where only the 5-hydroxy site has been modified. Preliminary bioactivity studies on these derivatives reveal that they have even better activity than luteolin. We have also developed strategies to selectively derivatise other hydroxyl sites of luteolin. Producing more of these derivatives will determine whether we can make even greater improvements.

Over the last decade there has been increased research interest to develop best methods to extract important compounds, such as flavonoids from food waste products.5 Our future plan, is to employ an optimised extraction method to source our natural flavonoids from food waste as starting materials for derivatisation.

Self-cleaning coatings for pre-painted steel roofing

Lakshini Dilesha Fernando Thewarashige | *School of Chemical Sciences*

Pre-painted steel roofing is extensively used in both residential and commercial constructions. The contamination of such roofs over time due to biological organisms and other environmental pollutants is a major aesthetic and functional problem. On the other hand roof cleaning is costly, laborious, time consuming and have accessing limitations. Harsh and toxic chemicals are also required to remove most of these contaminants. Therefore development of a commercial self-cleaning coating system on pre-painted steel (PPS) roofing is highly important and demanding.

The critical organism types and other pollutants on PPS roofing have already been investigated under Australian and few other different contexts. The activity of photocatalytic titanium dioxide (TiO2) powder, against these contaminants have also been studied in recent literate. However the commercialization of photocatalytic coatings on painted substrates has not yet been fully resolved mainly due to durability issues. The degradation of underlying paint components due to the activity of TiO2 is a major problem of applying photocatalytic coatings directly on a painted substrate. The development of a durable self-cleaning coating is also challenging as conventional binders can easily be degraded due to the activity of TiO2. Therefore this research is aiming to develop a durable photocatalytic self-cleaning coating system on PPS roofing for commercialization.

In this study, an additional protective layer will be introduced in between photocatalytic top layer and underlying paint layer to minimize paint degradation issue. The protective layer will be consisted of an ROS (reactive oxygen species) resistant resin system to obtain long lasting performance. The same resin system will also be used in the TiO2 photocatalytic layer to improve durability further. The performance will be evaluated before and after accelerated weathering. Outdoor exposure studies will also be used as a measure of success.

UniServices Poster abstracts

ARTS

Weaving Galicianness: Galician Prehistoric Art into Home Design

Ekaterina Volkova | *School of Cultures, Languages and Linguistics*

This poster presents the creative project in which I illustrate one of the possible ways to implement some findings of my doctoral research. In my thesis, I explore visual language as a vehicle for the expression of Galicianness, a set of the aspects of the national identity of Galicia, the northwest corner of current Spain, with its own language, literature and culture distinct from the rest of Spain. The preliminary results of my investigation detect national content in a wide range of visual forms and prove that visual culture in Galicia has played an important role in the construction and reaffirmation of its national identity. Visual references to Galician cultural heritage constitute essential elements of Galician national imagery, the totality of images and symbols that embody ideas of Galicia and induce patriotic sentiments.

In my project, I have created a set of cushions with the patterns inspired by Galician petroglyphs. Galician Rock art is characterised by a rich variety of petroglyphs and they are an important part of Galician cultural heritage. The title of my project "Weaving Galicianness" has a double meaning. Firstly, it directly refers to the main technique I used for this project; secondly, weaving as a process of making a fabric from interconnected elements, seems to me a successful metaphor for the process of the identity construction. Instead of a conventional art form, such as tapestry, I have opted for a home design object. On the one hand, home design brings to mind the idea of home, connected to the notion of 'homeland' and, therefore, to national identity. On the other hand, national imagery employed in utilitarian objects that we use in everyday life is a palpable way to evoke the sense of nation on everyday basis.

CREATIVE ARTS AND INDUSTRIES

The role of outdoor learning spaces in Innovative Learning Environments

Neda Farrokhi Afshar | *Architecture and Planning*

In recent decades, the shift from traditional and teacher-centred to innovative and student-centred education has led to an evolution in the architecture of learning environments. In 2000s, the Organization for Economic Co-operation and Development (OECD) proposed Innovative Learning Environments (ILE) in order to update the teaching methods and school design for 21st century. Following this worldwide movement, in Aotearoa New Zealand, the Ministry of Education introduced ILE in 2010. Subsequently, schools are now required to be designed or renovated according to ILE standards.

Schools' outdoor spaces can potentially complement indoor classroom space to facilitate modern pedagogies that are in accordance with ILE criteria. The broad advantages of Outdoor Learning Environments (OLE) are discussed in the literature. However, most of the academic studies on school architecture and ILE design guidelines are generally confined to the interiors of buildings. Therefore, research is necessary to provide architectural and spatial criteria to design the school grounds as a part of ILE, which is the aim of this study.

In this study, a mixed method of case study, plan analysis, and site observation is employed to critically assess the engagement of outdoor spaces in ILE-style education. The goal of the study is to improve the design of Outdoor Innovative Learning Environment (OILE) in primary schools by linking the Environmental Affordances and ILE pedagogy. The outcomes of this research are an architectural assessment tool and a collection of design recommendations for OILE.

EDUCATION AND SOCIAL WORK

Dance and drama in classroom

Fangyuan Cheng | *Education*

My study intends to generate stories from six participants in total to explore how dance and drama is encouraged in New Zealand primary classroom. I will invite these educators to discuss their perception about how they are encouraged or discouraged to integrate dance and drama in their classrooms. The purpose of doing this research is to inspire and encourage generalist teachers in New Zealand primary schools to integrate dance and drama in class. The intention of collating and analyzing of the educators' experiences and suggestions is to provide a series of brief narratives which will better inform the New Zealand Ministry of Education to potentially optimize the arts (dance and drama) integration into curriculum development.

ENGINEERING

Liquefaction susceptibility of New Zealand infrastructure

Amelia Lin | *Civil and Environmental Engineering*

Liquefaction is the process of soil changing its state of matter and acting like a fluid as a result of strong ground shaking. It can cause severe damages to the built environment, such as settlement of buildings or distortion of roads. Because of its young coastal sediments and its location along the Pacific Basin Ring of Fire, large areas of New Zealand are susceptible to liquefaction. A proper assessment of this phenomenon, however, relies on a number of soil features, which are usually obtained through expensive and labour-intensive field investigations. Because of these constraints, traditional methods do not seem suitable for the assessment of an entire infrastructure network. Therefore, the research focuses on an alternative approach to provide a national-scale evaluation of New Zealand's transportation and power transmission facilities. The approach is based on a geospatial model, which uses globally available geographic information, such as slope or water table depth, as well as case history data to estimate the liquefaction susceptibility in any location of New Zealand. Assisted by geographic information systems (GIS), susceptibility maps for different transportation networks (state highways, rail, and bridges) and power transmission were developed and analysed. The results indicate that bridges are the most susceptible infrastructure facility; their proximity to rivers significantly increases the potential for liquefaction. In contrast to that, transmission structures, which are less frequently located on loose and saturated soil, show the lowest exposure to liquefaction. Further research needs to link susceptibility results with seismic hazards in New Zealand in order to estimate the probability and extent of liquefaction damage. In addition, the criticality of infrastructure (e.g. traffic volume) should be considered as part of this process to better quantify the impact of liquefaction damage to the wider economy and society.

Building Back Towards Cyclone Resilience of Housing Structures in the Developing World

Diocel Harold Aquino | *Civil and Environmental Engineering*

Tropical cyclones cause immense damage to properties, particularly to housing structures. The impacts are heightened in developing countries, which are said to be more vulnerable to natural disasters. The aim of this research is to identify the factors contributing to the development of resilient housing structures in the context of post-disaster reconstruction. We look into the reconstruction in cyclone-stricken communities in Fiji. The factors span across technical, social, economic, and legislative domains.

Wear prediction in a novel extra-articular knee prosthesis

Mohd Sabri Hussin | *Engineering Science*

Symptomatic knee osteoarthritis (OA), a commonly occurs among adults 60 years of age or older. The most popular treatment for severe OA is Total Knee Replacement, in which much of the natural knee compartment is sacrificed and replaced with artificial components. In this project, a novel knee implant is proposed which is radically different to most current designs. The prosthesis transfers away some load to avoid the prolonged high-stresses experienced by the articulating surfaces.The prosthesis is extra-articular, the native knee anatomy is preserved and a full range of motion is maintained.The purpose of this research is to study the wear arising at the implant surfaces with a view to predicting implant feasibility and lifetime.

Different typical knee-loadings were considered in tribological testing to determine wear coefficients, and later loadings were used to validate wear models incorporating these coefficients. Abaqus FEA was used for the computational studies. The implant was designed in Solidworks using an anatomically and kinematically correct knee joint acquired from MRI and positioned based on dynamic single-plane X-ray fluoroscopy. Knee movement and loading were prescribed as per ISO standards 14243-1 and 14243-3.

Wear coefficients of approximately 4.1E-10 [mm3/N.mm] were obtained from 3 sets of experiments. The computational model was then used to predict BOR wear volumes, and experimental and numerical results were within 5-10%. Once verified, the wear model was incorporated into the computational model of the implant. Predicted wear at the articulating surfaces was 18.6 mm3 (~17.6 mg) per million cycles.

A computational model was able to predict wear volumes to within 5-10%. A comprehensive computational model of a loaded novel knee prosthesis predicted wear volumes of an order similar to that observed with other implants, e.g. the Oxford mobile bearing. The study predicts satisfactory lifetimes of this prosthesis in terms of wear.

The Effect of Spray Drying Parameters on the Particle Size of Calcium Carbonate Spheres

Harpreet Kaur Chahal | *Chemical and Materials Engineering*

A common method used to fabricate ceramic coatings is thermal spray. The preparation of powder for thermal spray is important, as it dictates the powder and coating properties. Particle size and powder flowability are two important properties of a thermal spray feedstock powder. The particle size required depends on the material being sprayed, and the flowability is dependent on the particle morphology, where spherical particles provide good flowability. Spray drying is a common technique used to produce spherical, agglomerated particles, in a certain size range. The aim of this work was to study the effect of different spray drying parameters on the particle size of calcium carbonate particles. The parameters studied were the concentration of solid in the feed suspension, the feed flow rate and the gas flow rate. Spray drying effectively produced porous, spherical calcium carbonate particles in various sizes, from the needle-like morphology starting material. The effect of the parameters on the particle size of calcium carbonate spheres was evaluated using a 23 factorial statistical design. The statistical results indicate that an increase in gas flow rate reduces the particle size. Whereas, the feed flow rate and solids concentration of the feed had little effect on the particle size.

MEDICAL AND HEALTH SCIENCES

Characterisation of Glutamate Receptor Changes in an In Vivo Mouse Model of Alzheimer's Disease

Jason Yeung | *Department of Anatomy and Medical Imaging*

Alzheimer's Disease (AD) is the leading type of dementia worldwide, with an increasing burden due to an aging population. Glutamate is the main excitatory neurotransmitter in the CNS, and the glutamatergic system is extensively implicated in AD pathophysiology, the mechanisms of which are still unknown.

To quantify changes in selected glutamate receptors and transporters in the CA1, CA3, and DG (Dentate Gyrus) regions of the hippocampus in an AD mouse model. C57Bl6 mice were bilaterally injected with amyloid beta, euthanised and sections retrieved 30 days post injection. Free-floating immunohistochemistry was used to target and visualise specific glutamate receptor subunits and transporters. ImageJ was used to measure integrated densities of specific regions and cell layers. Kruskall-Wallis tests were conducted using Prism to examine differences.

We report significant decreases in density in glutamate receptor subunits GluA1 (str. oriens and radiatum), GluN2A (str. oriens, pyramidale, and radiatum), and VGluT (str. radiatum) in the CA1 region of Aβ injected mice compared to artificial cerebrospinal fluid (ACSF) injected and naïve control mice. Glutamate receptor subunits GluA2, GluN1 and transporter VGluT2 showed no changes in expression. Findings indicate the expression of glutamatergic receptor subunits and transporters show brain region and layer specific changes in AD, suggesting complex activation mechanisms and expression changes during neuropathology. Such changes in expression has the potential to offset the excitatory-inhibitory balance within the brain, with implications on disease progression and normal synaptic functioning.

Optogenetic modulation of GABA signaling-dependent hippocampal neuronal function as a potential treatment for Alzheimer's Disease

Soo Kim | *Department of Anatomy and Medical Imaging*

The loss of memory and cognitive function in Alzheimer's disease (AD) is largely caused by extensive neurodegeneration primarily in the hippocampus and cortex and disruption of the excitatory system has been considered the major player in the AD pathogenesis. Recently, the role of inhibitory gamma-aminobutyric acid (GABA)ergic system in the progression of AD has gained considerable attention with emerging evidence showing remodeling of GABAergic system in AD. However, a clear relationship between the GABAergic alterations and AD pathogenesis is still not well understood. Optogenetics provide selective cell-type specific modulation of GABAergic signaling which will aid in investigating the therapeutic potential of GABAergic system in AD.

The aim of this study is to establish an *in vivo* optogenetic approach that enable specific control of the GABAergic neuronal activity in the mouse hippocampus. Animals were bilaterally injected with a lentivirus containing a GAD67 promoter tagged with YFP into the CA1 to achieve specific expression in GABAergic cells. Varying CA1 coordinates based on previous studies and expression periods (30d, 40d and 50d) were tested to evaluate the optimal CA1-GABAergic specific expression of virus for further experiments.

Injection of virus at both the dorsal and ventral CA1 coordinates achieved the most optimal spatial expression of eYFP in GABAergic cells in the CA1. 40days showed maximum eYFP expression in GAD67 cells in the CA1. Discussion: This first part of in vivo optogenetic approach will be used to examine if optogenetic stimulation of GABAergic cells in the hippocampal CA1 can restore cognitive deficit in an AD mouse.

Characterisation of the Neuropathological Hallmarks of Huntington's disease using Tissue Microarrays

Adelie Tan | *Department of Anatomy and Medical Imaging*

Huntington's disease (HD) is an autosomal dominant neurodegenerative condition. Neuropathologically, HD is characterised by the aberrant accumulation of mutant huntingtin (mHTT) protein, and region-specific loss of certain cellular populations within cortical and subcortical brain regions.

This study aims to characterise HD cortical neuropathology using a human tissue microarray (TMA) and high-content screening approach to investigate the feasibility of utilising this method to study HD. The TMA utilised in this study contains paraffin-embedded 2 mm middle temporal gyrus (MTG) samples from up to 28 HD and 28 control human brains. 3'3-diaminobezidine (DAB) immunohistochemistry was performed on the TMA sections to detect pyramidal cells (SMI-32), three populations of interneurons (calbindin, calretinin, and parvalbumin), and mHTT aggregates (1C2 and 1F8). The immunolabeled TMAs were imaged using the automated V-slide scanner and analysed using Metamorph software.

A significant 27% reduction in SMI-32+ pyramidal neuronal density and a 36% increase in calbindin+ interneuron density was observed in HD samples. No changes were observed in calretinin+ or parvalbumin+ interneuronal populations between control and HD cohorts. There was a significant 187% and 84% increase in IC2+ and IF8+mHTT aggregate number respectively in HD. The TMA data presented recapitulates classical HD neuropathological features such as SMI32+ pyramidal cell loss and the accumulation of IC2+ and IF8+ mHTT aggregates within the 2mm cortical samples. Changes in pyramidal neurons and mHTT aggregates are consistent with previous manual quantitative studies in whole tissue sections, reinforcing the TMA platform as a feasible tissue-conserving tool to conduct future high-throughput studies of novel neurochemical markers of HD pathogenesis.

Cerebrovascular Expression of GABA Signalling Components in the Human Middle Temporal Gyrus

Karan Govindpani | *Department of Anatomy and Medical Imaging*

Cerebrovascular dysfunction is associated with the pathogenesis of a range of neurological disorders. The inhibitory neurotransmitter gamma-aminobutyric acid (GABA) can regulate changes in blood flow through neurovascular coupling, but the underlying mechanisms are unclear. The GABA signalling system is structurally heterogeneous, comprising multiple subtypes of GABA receptors and transporters. The effect of GABA on the cerebral vasculature may be relevant to cerebrovascular dysfunction in diseases involving the GABAergic system, including Alzheimer's disease and other dementias. However, the expression of specific GABA receptors and transporters on the human cerebral vasculature has never been demonstrated.

In this study, we investigated the cerebrovascular expression of GABA signalling components in the post-mortem human middle temporal gyrus (MTG). Fluorescence immunohistochemistry and confocal imaging were utilised to detect the cerebrovascular expression of GABA signalling components in post-mortem MTG sections.

We report, for the first time, the endothelial expression of the alpha2, alpha3, alpha5, beta1-3, gamma3 and epsilon $GABA_A$ receptor ($GABA_AR$) subunits, as well as the GABA transporters, in the human MTG cerebral vasculature. Some $GABA_AR$ subunits, including beta1 and beta2, were expressed at low levels. We also observed the expression of the beta3 $GABA_AR$ subunit on perivascular pericytes, contractile cells that mediate a variety of important vascular functions. Alpha1 subunits were not found to be expressed on the vasculature, in contrast with their widespread incorporation into neuronal $GABA_ARs$. Discussion: $GABA_ARs$ may be expressed with a unique subunit composition on the cerebral vasculature, and may potentially play a role in health and disease.

Extrasynaptic alpha 5 type GABAA receptors as therapeutic targets for Alzheimer's disease

Chitra Vinnakota | *Department of Anatomy and Medical Imaging*

Alzheimer's disease (AD) is a progressive neurodegenerative disorder for which no cures or cognition-restoring therapies have yet been discovered. γ-aminobutyric acid (GABA) is the primary inhibitory neurotransmitter in the brain and plays a key role in regulating the balance between neuronal excitation and inhibition. There is increasing evidence which suggests a remodelling of the GABAergic system in AD and thus it might represent an important therapeutic target. The compound, 3-(5-Methylisoxazol-3-yl)-6-[(1-methyl-1,2,3-triazol-4-yl) methyloxy]-1,2,4-triazolo[3,4-a]phthalazine (α5IA) acts as an inverse agonist of α5 subunit containing GABAA (α5GABAA) receptors and has displayed cognition enhancing properties in previous studies.

This study aimed to characterise the effects of α5IA on amyloid beta (Aβ1-42)-induced molecular and cellular changes in an in vitro AD model. Methods: Mouse primary hippocampal cultures were exposed to either Aβ1-42, α5IA and Aβ1-42, α5IA alone or vehicle and changes in cell viability were assessed.

Treatment with 1nM Aβ1-42 caused 51.5% cell death after 6 hours. Treatment with 100nM α5IA, however, reduced Aβ1-42-induced cell loss by 23.8% (****p<0.0001) after 6h. Cell viability after 5 days of treatment with α5IA was also measured and revealed a decrease in Aβ1-42-induced cell death by 15.0% (**p<0.01). Treatment with the compound altered Aβ1-42-induced induced changes in both intracellular and extracellular GABA levels as well as changes in the expression of various GABAergic signalling components, including α5GABAA receptors, at the RNA level which may underlie the neuroprotective effects. Discussion: In summary, α5IA might hold neuroprotective potential and represent a new therapeutic avenue for treating cognitive dysfunction in AD.

Comparison of Infant and Adult Gluteus Minimus Architecture

Luke Bradshaw | *Department of Anatomy and Medical Imaging*

Anatomically an infant is not a miniature adult. Although an important muscle in weight bearing and gait, development of gluteus minimus(Gmin) architecture has not been studied. Muscle architecture, the arrangement of contractile and connective tissue elements, is an important determinant of function. Knowledge of differences between adult and infant muscle architecture is essential for clinicians managing the paediatric population.

The aim of this study is to determine the 3D spatial relationships of the fibre bundles, aponeuroses and tendons of an infant Gmin, quantify its architectural parameters and compare with the adult. One 6 month old formalin embalmed specimen was used. The contractile and connective tissue elements throughout the volume of Gmin were serially dissected and digitised (Microscribe®G2X) in situ. 3D models were constructed in Autodesk® Maya®. Architectural parameters fibre bundle length(FBL), pennation angle(PA), and physiological cross sectional area(PCSA) were computed and compared between the infant and adult.

Adult and infant Gmin had anterior superficial, anterior deep, middle and posterior partitions. In the infant, 1)posterior, middle and anterior superficial parts attached to the deep surface and edge of a circular aponeurosis; in the adult all partitions attached to the deep surface of a fan shaped aponeurosis covering inferior 2/3 of GMin, 2)mean FBL of anterior superficial and deep parts was similar; in adult there were large differences, 3)mean PA of anterior superficial and deep partitions differed significantly from adult Gmin. The infant is not a miniature adult: differences in architecture and aponeurosis morphology could not be explained by proportional size increases alone.

Investigation of GABA signalling in an in-vivo Alzheimer's Disease Mouse model

Thulani Palpagama | *Department of Anatomy and Medical Imaging*

GABA is the main inhibitory neurotransmitter of the central nervous system. GABA is synthesized by glutamic acid decarboxylase (GAD), packaged in vesicles through vesicular GABA transporter (VGAT), and acts on GABAA and GABAB receptors. GABA clearance relies on GABA transporters (GATs) and it is metabolised by GABA transaminase (ABAT). Changes in the GABAergic systems have been identified in the progression of Alzheimer's disease (AD). AD is characterized by accumulation of neurotoxic beta-amyloid (Aβ) and impaired cognitive function.

In this study, we have characterised molecular changes of GABA signalling components in the hippocampal CA1 region and dentate gyrus (DG) of aged, male wild-type mice injected bilaterally with $A\beta_{1-42}$ in the CA1 region of the hippocampus. 3 days after hippocampal stereotactic $A\beta_{1-42}$ administration, prior to cell loss, the CA1 and DG regions were dissected for Western blotting. Naïve control and ACSF vehicle injected mice were used as controls in this study. Each group had an n=3.

In the CA1 region no significant changes were identified in the expression of GABA signalling components ABAT, VGAT, GAT-3, BGT-1 and the alpha 1,2,3,5, beta 3 and gamma 2 GABAA receptor subunits. In the DG region we saw no significant changes in ABAT, BGT-1, and the alpha 1,2,3,5, beta 3 and gamma2 GABAA receptor subunits. These results suggest that the GABAergic system is relatively well preserved prior to $A\beta_{1-42}$ -induced cell loss in this *in vivo* AD model. Therefore, bolstering the GABAergic system may serve as a potential therapeutic target for AD.

Architecture of the Infant Gluteus Medius: A 3D modelling study

Ethan Breinhorst | *School of Medicine*

Gluteus medius (GM) is an important muscle in adult gait with defined functional partitions involved in specific hip movements. Knowledge of adult architecture, the arrangement of the contractile and connective tissues within the muscle, informs understanding of GM's functional significance. How the architecture, partitions and function of infant GM develop into adult form is unknown. Knowledge of this process could aid in understanding developmental pathologies (e.g. cerebral palsy).

The aim of this study is to determine and quantify the 3D musculoaponeurotic architecture of Infant GM and compare to adult GM (previous data). Methods: One 6-month-old, female, formalin embalmed specimen was used. GM was exposed. Fibre bundles and aponeuroses were serially dissected, digitised (Microscribe G2X) and modelled in 3D (Autodesk® Maya®). Architectural parameters were quantified: fibre bundle length (FBL), pennation angle (PA) and physiological cross-sectional area (PCSA).

There are no large aponeuroses or tendons of insertion in infant GM. Infant GM does not have superficial and deep heads, however, three partitions, anterior, middle and posterior, are present in both adult and infant. The anterior partition of the infant had the longest mean FBL and the posterior the shortest; adult GM has homogeneous mean FBL. The proportionate PCSA of the anterior and middle partitions of adult and infant GM differ. The infant GM does not have the same musculoaponeurotic architecture as the adult. In the infant, the connective tissue elements were not developed and the muscle belly was thin. Significant changes in GM architecture must occur along the developmental spectrum from infant to adult.

Relationship between Serum Electrolytes and Ileus: a Joint Clinical and Theoretical Study

James Penfold | *School of Medicine*

Post-operative ileus poses a significant clinical and economic burden, occurring in around 15% of patients following major abdominal surgery. Peri-operatively we see dramatic fluid shifts and changes in serum electrolyte concentrations, potentially impairing gastrointestinal motility. However, the role of electrolyte derangements in the pathophysiology of ileus has not been clearly elucidated.

A joint clinical-theoretical study was undertaken to evaluate peri-operative electrolyte trends, their impact on ileus occurrence, and motility cellular function (interstitial cells of Cajal (ICC) and smooth muscle (SMC)).

Data were prospectively collected from 327 patients undergoing elective colorectal surgery. Parametric analyses were performed to determine an association of peri-operative electrolyte concentrations with ileus. A biophysically-based ICC-SMC mathematical model was developed to theoretically evaluate the impact of extracellular electrolyte concentrations on cellular functions based on the experimental values.

Parametric analyses demonstrated ileus was associated with mean pre-operative magnesium, post-operative day one calcium and creatinine, and post-operative day three chloride, sodium, potassium and creatinine ($P<0.05$). Deficits beyond reference range in ileus patients were most common for chloride (Day 3: 13.6% ileus vs. 10.5% no ileus) and sodium (Day 3: 29.5% ileus vs. 18.5% no ileus). Models demonstrated a 32.8% reduction in frequency of electrophysiological activities for ICC and SMC with a 15% reduction in extracellular NaCl. Electrolyte abnormalities are common in ileus, with sodium and chloride deficits being most prominent. Pronounced effects on electrophysiological functions suggest these abnormalities impart mechanistic impairment on gut motility. Clinical efforts should be directed to correcting electrolyte deficits in ileus.

Evidence Against the Use of Mitochondrial DNA as a Predictor of Blastocyst Quality

Eleanor Adviento | *Department of Obstetrics and Gynaecology*

Mitochondrial DNA (mtDNA) tests are commercially available in fertility clinics overseas for blastocyst selection, despite conflicting evidence. Objectives: To investigate if mtDNA content can predict blastocyst quality, and is concordant throughout different areas of the blastocyst. C57BL/6 mouse blastocyst morphology was graded according to the Gardner and Schoolcraft system. Real-time qPCR assays for Nd5 and Apob were used to quantify the absolute number of mtDNA and nuclear DNA molecules, respectively, in blastocysts. Normalised mtDNA content was calculated using the mitochondrial-to-nuclear DNA ratio. Concurrently, good quality blastocysts were dissociated into 3-5 fractions. Genomic DNA was extracted from each fraction, and normalised mtDNA content was determined.

Despite the inverse correlation between blastocyst quality and number of mtDNA per blastomere ($p < 0.0001$), there was no correlation between blastocyst quality and total number of mtDNA molecules ($p = 0.0750$). However, interestingly, blastocyst quality was inversely correlated with the total number of blastomeres ($p < 0.0001$). 52% of dissociated blastocysts did not have highly concordant mtDNA distribution (CV > 20%). The inverse correlation between blastocyst quality and normalised mtDNA content is likely due to the total number of blastomeres, rather than the total number of mtDNA molecules in the blastocyst. Therefore, the total mtDNA content is not an indicator of blastocyst quality. Rather, the total number of blastomeres may be a better predictor of blastocyst quality. Since the majority of blastocysts had an asymmetrical distribution of mtDNA molecules, the mtDNA content of biopsy samples may not represent the whole blastocyst.

Evaluating an educational intervention to improve the health literacy of adolescents regarding non-prescription medicine use

Surbhi Samant | *School of Pharmacy*

The 2006 Adult Literacy and Life Skills Survey identified poor health literacy amongst approximately 87% of Māori and 69% of non-Māori aged 16–18 years. This has implications for adolescents' ability to make appropriate healthcare related choices, for example in self-medication with over-the-counter medicines.

The aim of this study is to assess the effectiveness and acceptability of a short educational intervention, tailored to adolescents (secondary school students aged 14-18 years), developing health literacy skills within the context of over-the-counter medicines. An educational intervention developed from a 2017/2018 Masters of Pharmacy research (School of Pharmacy and Pharmacology, Griffith University, Australia) was adapted to suit the New Zealand environment. The research material was reviewed by Māori and Pacific cultural advisors and a Youthline advisory group in Auckland and modified according to their feedback. Study participants are being recruited through email invitations to schools or groups. Anonymous-linked baseline and post-intervention data is being collected via online and paper-based surveys.

Recruitment and data collection for the project is currently underway, and data analysis to date will be presented at HealtheX. Preliminary results from two participating student groups (n=60) show mainly high pre-intervention survey scores (mean 9.36/11) and a small increase in the mean post-intervention survey score (9.75/11). Participants appeared satisfied with how the teaching content was explained (n=46/59). Findings to date indicate that the intervention appears acceptable to students and to improve aspects of adolescent health literacy with respect to over-the-counter medication use.

Differences in neurotransmitter levels between depressed patients and healthy controls: a systematic review

Kate Godfrey | *School of Pharmacy*

Dysfunction of gamma-aminobutyric acid (GABA) and/or glutamate neurotransmitter systems have increasingly been implicated in the aetiology of Major Depressive Disorder (MDD). It has been proposed that alterations in GABA and/or glutamate result in an imbalance of inhibition and excitation.

The primary aim of this study is to determine if GABA, glutamate and/or Glx (composite measure of glutamate and glutamine) levels in the brain, measured by Magnetic Resonance Spectroscopy (MRS) techniques, differ in patients diagnosed with MDD when compared to healthy controls. In a review of the current literature, we identified studies using MRS to examine the neurotransmitters GABA and glutamate in patients diagnosed with MDD and healthy controls.

Results showed patients with MDD had significantly lower GABA levels compared to controls (-0.35[-0.61,-0.10], p=0.007). No significant difference was found between levels of glutamate. Sub-analyses were performed, including only studies where the Anterior Cingulate Cortex (ACC) was the region of interest. GABA and Glx levels were significantly lower in the ACC of MDD patients (-0.56[-0.93,-0.18] p=0.004, and -0.52[-0.90,-0.15] p=0.006). This review indicates widespread cortical reduction of GABA in MDD, with localised reduction of glutamate in the ACC. However, given both GABA and glutamate appear decreased a simple interpretation in terms of an imbalance of overall excitation-inhibition is not feasible.

Formulation and characterization of a glutathione functionalised pH-sensitive liposomes for brain drug delivery

Joy Reginald-Opara | *School of Pharmacy*

Neurodegeneration and neuroinflammation are prevalent diseases nowadays. Effective therapeutics is limited due to non-specific bio-distribution and presence of the blood-brain barrier (BBB) that tightly regulates the diffusion of drugs. New treatment options to enhance drug delivery across the BBB with reduced off-target effects is needed. The aim of this study is to develop and characterise glutathione-DSPE-PEG conjugate. To formulate glutathione functionalised liposomes by post-insertion of the glutathione-DSPE-PEG conjugate into pH-sensitive liposomes. Methods: Glutathione-DSPE-PEG polymer was synthesised by a thiol-maleimide Michael-type addition reaction at pH 7.4 using glutathione and DSPE-PEG-maleimide as reacting agents. The resulting polymer was characterised by 1H-NMR. The reaction was also indirectly quantified using HPLC analysis of free glutathione. Following, PEGylated pH-sensitive liposomes were prepared, by modification with the glutathione-DSPE-PEG.

The disappearance of the resonance protons from the C=C in maleimide group of reacting polymer in 1H-NMR spectra of the glutathione-DSPE-PEG, confirmed the formation of the conjugate. This is also confirmed by the proportional decrease in glutathione concentration after the reaction. The pH-sensitive liposomes before modification with glutathione-DSPE-PEG had a size of 79.3 ± 0.2 nm. The results from the quantification of glutathione that

conjugated and further formulation work are on the way. The study results will provide useful information to develop a therapeutic formulation for brain delivery. PEGylation of the liposomes would increase liposomes circulation time in the blood. Glutathione ensures improved uptake across BBB into the brain through glutathione-receptors mediated endocytosis. The pH sensitivity reduces drug degradation in the lysosomes once in the cells.

Preformulation studies for the development of a novel suppository to deliver amoxicillin

Trusha Purohit | *School of Pharmacy*

There is a lack of child-friendly dosage forms for the treatment of various diseases such as pneumonia, especially in resource-poor countries. Amoxicillin is a broad spectrum, amino-penicillin antibiotic used in the treatment of different infections. Amoxicillin suppositories could offer a low-cost, easy-access treatment option for the treatment of pneumonia.

The aim of this study is: (1) To select suitable materials to formulate a suppository to promote the absorption of amoxicillin. (2) To develop a high-performance liquid chromatography (HPLC) method for estimation of amoxicillin in the formulation development. Interference of bioadhesive polymers on melting and cooling behaviour of suppository bases was determined using differential scanning calorimetry (DSC). The HPLC method was developed using a C18 column with a mobile phase containing phosphate buffer (50 mM, pH 5), methanol and acetonitrile (93:5:2v/v). The method was validated according to the International Council for Harmonisation (ICH) guidelines.

Bioadhesive polymers showed a decrease in the melting point of the potential suppository bases. However, polyvinyl pyrrolidone interfered with the cooling behaviour. A simple, rapid HPLC method was developed with the linearity in the range of 0.5 – 50 µg/ml (R2 >0.999). Validation of the HPLC method is ongoing. Rectal delivery is most suitable for paediatric patients. Bioadhesive polymers would help to enhance the rectal absorption of amoxicillin by improving retention in the rectum. The HPLC method could be potentially used in the analysis of amoxicillin for in vitro and in vivo studies of the proposed amoxicillin suppository.

The Role of the Cystine/Glutamate Antiporter in Glutamate Metabolism in the Mouse Retina

Luis Knight | *Department of Physiology*

The Cystine/Glutamate Antiporter (CGAP) facilitates the uptake of extracellular cystine and export of intracellular glutamate. CGAP has been localised to the outer plexiform layer (OPL) of the rat retina, indicating that CGAP may contribute to glutamate metabolism and signalling. Observations of CGAP knockout (KO) mice revealed that KO mice develop retinal spots at earlier ages than wild-type (WT) mice, reminiscent of drusen deposits seen in human age-related retinal disorders.

The aim of this study is to elucidate how loss of CGAP may contribute to the early formation of drusen-like spots, which are associated with accumulation of metabolic waste products, we investigated the role of CGAP in glutamate metabolism and energy supply. Retinas from 6 week- and 9 month-old WT and KO mice were collected, and lactate dehydrogenase (LDH) activity and ATP concentrations measured. Glutamate/glutamine levels and distribution were measured using silver-intensified immunogold labelling.

6 week-old, but not 9 month-old, KO retinas exhibited a significant decrease in LDH activity compared to WT ($p=0.03$). There were no differences in ATP levels between WT and KO for either age group. Increases in glutamate immunoreactivity in the OPL ($p=0.0157$) and photoreceptors ($p=0.0052$), and decreases in glutamine immunoreactivity in Müller cells ($p=0.01$), were observed in the KO compared to WT. These results show that CGAP removal disrupts lactate metabolism and alters glutamate-glutamine balance in the retina, suggesting that early metabolic dysfunction increases retinal susceptibility to drusen formation in later life. Further research will assist in the development of novel treatments to prevent or reverse drusen formation.

Shank2 Changes in Shank3-/- Autism Mouse Model

Yukti Vyas | *Department of Physiology, Centre for Brain Research*

Autism Spectrum Disorders (ASDs) are characterised by repetitive behaviours and social communication deficits. ASDs have a strong genetic basis with many ASD-associated mutations found in synaptic proteins. Shank proteins are master regulators of excitatory synapses and mutations in SHANK genes have been found in ASD patients. Zinc, a commonly found mineral in the brain, binds to Shank2 and Shank3 increasing their recruitment and stabilisation in the synapse. Zinc deficiency is a risk factor in ASD, and dietary zinc supplementation rescues behavioural and physiological deficits in the Shank3-/- mouse model of ASD.

To begin understanding the mechanisms underlying this rescue, we aimed to determine whether zinc supplementation enhances the synaptic recruitment of Shank2, an isoform of Shank3, in these Shank3 deficient mice. Cortico-striatal slices from wildtype and Shank3-/- mice fed normal (30 parts per million, ppm) and high (150ppm) zinc diets were immuno-stained for Shank2, presynaptic marker VGluT1, dendritic marker MAP2 and nuclear stain Hoechst, and imaged using confocal microscopy.

Dietary zinc supplemented Shank3-/- mice were observed to express significantly higher intensity levels of synaptic Shank2 in comparison to wildtype and Shank3-/- mice on the normal zinc diet. However, this increase in Shank2 was not accompanied by a rescue of synaptic density. These data suggest that high dietary zinc enhances the recruitment and stability of Shank2 at cortico-striatal excitatory synapses, possibly as a compensation for the lack of Shank3, which may be the mechanism underlying the zinc supplementation induced rescue of ASD phenotypes in Shank3-/- mice.

Inter-tissue crosstalk between the lens and ocular humours

Jinny Kim | *Department of Physiology*

Glutathione (GSH) and ascorbate are two principal antioxidants of the lens which protect the lens from oxidative damage and cataract. Studies show that the rat lens acts as a GSH reservoir and exports GSH via members of the Multidrug resistance-associated protein family (Mrps). This suggests that the lens can influence the composition of the ocular humours by sourcing antioxidants to maintain the health of other tissues of the eye.

The aim of this study is to determine if human lenses are capable of exporting antioxidants. Human donor lenses of varying ages were cultured under hypoxic conditions for 1 and 5 hours. Lenses and media were then collected and measured for GSH and oxidised GSH (GSSG), and lactate dehydrogenase (LDH) levels to assess membrane integrity. To identify the mechanism of GSH efflux, lenses were also cultured in the absence or presence of MK571, an inhibitor of Mrps for 1 hour. Human donor lenses were shown to release GSH after 1 or 5 hours of culture. However, unlike in rat lenses, GSSG, but not GSH, was the predominant form released. Moreover, in the presence of Mk571, total GSH was blocked by 40% indicating that GSH efflux is mediated by Mrps. These results indicate that the human lens is able to export total GSH via Mrp-mediated pathways suggesting that nearby tissues may able to accumulate this source of GSH. Future studies will focus on whether ascorbate can also be released from the lens, and if so, provides a novel role for the lens in maintaining overall ocular health.

Validation of NODDI-MRI for detection of cortical brain injury following peripheral inflammation in neonatal rats

Petra White | *Department of Physiology*

Preterm infants have high rates of neurodevelopmental disabilities associated with microstructural MRI changes. However, the exact relationship between MRI parameters and histopathological outcomes remains unclear. The Neurite Orientation Dispersion and Distribution Index (NODDI) is a novel diffusion MRI technique, proposed to measure neuronal branching.

The aim of this study is to validate the relationship between MRI-NODDI parameters and neuronal dendritogenesis during development of the

cerebral cortex, and examine cortical changes in a preterm-equivalent rat model of inflammatory brain injury. *Experiment 1*: Sprague-Dawley rat pups collected at postnatal day (PND)1, 7, 14, and 21, and brain tissues impregnated with Golgi solution or fixed for ex-vivo MRI-NODDI analysis (9.4T Varian). *Experiment 2*: Rats received daily intraperitoneal lipopolysaccharide (LPS; 0.3mg/kg) on PND1–3, with recovery until PND21. Brain tissues were collected for Golgi/MRI-NODDI. In Golgi tissues, the complexity of pyramidal neurons in the somatosensory and motor cortices were assessed (Neurolucida). For MRI, the changes in fractional anisotropy (FA), orientation dispersion index (ODI), intracellular volume fraction, and isotropic volume fraction were calculated in the somatosensory cortex.

LPS was associated with a significant reduction in cortical volume at PND21, without evidence of cell death or loss of neurons. NODDI analysis showed a significant decrease in cortical ODI and increase in FA at PND21. Preliminary data indicate a significant reduction in dendritic complexity in the infragranular somatosensory cortex. Analysis of dendritic changes and the relationship to NODDI parameters during development is ongoing. Validation of NODDI may provide a novel technique for assessing cortical pathology in preterm-born infants.

Co-designing a mental wellbeing initiative for Pacific tertiary students: a pilot study

Leina Tucker-Masters | *School of Population Health*

Research both from New Zealand and abroad has identified Pacific youth and university students as populations vulnerable to experiencing mental illness. Young Pacific university students may therefore have increased need for appropriate mental health services.

The primary aim of this pilot study was to co-design a mental wellbeing initiative for Pacific undergraduate students at a tertiary institution. A secondary aim was to identify unique stressors or challenges that might impact Pacific undergraduate mental wellbeing. A literature review looked at the mental wellbeing of university students and Pacific youth in New Zealand and abroad. Interviews were conducted with nine key informants at the tertiary institution. Two focus groups were conducted with eight Pacific undergraduate students aged 18 – 24. The principles of co-design and the research methodology of Talanoa were utilised during the focus groups and interviews.

Nine themes summarised the risk and protective factors for Pacific undergraduate mental wellbeing: family, culture, personal expectations, socioeconomic pressure, identity, spirituality, Pacific at a Western institution, unpreparedness, and relationships. Participants had mixed opinions on the accessibility of current mental wellbeing services. Finally, participants produced their own mental wellbeing initiatives for Pacific undergraduates at university. This pilot study has shed light on the unique challenges and strengths that could affect the mental wellbeing of Pacific undergraduates. The research has also identified user opinions of current services available. Participants had a wide variety of ideas for services. The findings may provide evidence for services that cater to Pacific undergraduates.

LIGGINS INSTITUTE

Feasibility of breastmilk collection from mothers of moderate-late preterm neonates to deliver amoxicillin

Laura Galante | *Liggins Institute*

Preterm birth is often associated with poor lactation outcomes, exposing babies to higher risk of morbidity. Understanding the relationship between maternal health, breastmilk composition, and infant growth and development is essential to improve current nutritional strategies. However, the success of standardized breastmilk collection for research purposes in a stressful environment with the added complication of lactation challenges has not been assessed previously.

The aim of this study is to assess the rate of success of breastmilk collection from mothers of moderate-late preterm neonates at different stages of lactation. Methods: Breastmilk was collected at days 3, 5 and 10 after birth and at 4 months. Collection was performed between 10 am and 12 pm, following a standardised pre-collection routine, and using standardized collection material. The frequency of breastmilk collection was compared with chi-squared analysis against the expected collection rate (100%). Reasons for missed collection were evaluated.

In hospital (days 3, 5 and 10 after birth), 21% (n=43) of samples were missed, mostly due to low maternal milk supply (n= 18, p=0.005). At 4 months, 62% (n=34) of samples were missed, 65% (n=22) of them due to cessation of breastfeeding. As a result, the breastfeeding rate at 4 months for the study population (40%) was significantly lower than the national breastfeeding rates at 3 (79%) and 6 (69%) months (p<0.001). The success of breastmilk collection was lower than anticipated. Further studies should account for this reduction in breastmilk collection success, and investigate the barriers associated with milk supply issues experienced by these mothers.

SCIENCE

Sexual deception: Hallmarks of a successful strategy

Alexandra Kai Fong | *School of Biological Sciences*

Sexually deceptive orchids exploit their insect pollinators, the plants benefit from pollination, but offer nothing in return to insects fooled into mating with flowers. This deception can impose potentially acute costs on pollinators like sperm wastage - how can these systems persist over evolutionary time? How have these highly exploited pollinators evaded extinction?

Here, I test a new hypothesis: deceived pollinators have resilience traits which both protect and predispose them to deception. I have three aims; 1) to identify putative resilience and counter-adaptive traits from the literature, to create a database of morphological and behavioural traits of deceived pollinators, and test for correlations between pollinator traits and orchid fitness, 2) use theoretical models to test how resilience traits from the database can buffer extinction risk, and 3) using museum specimens, compare possible counter-adaptive traits of commonly deceived pollinator species from areas with and without sexually deceptive orchids, via a geographic mosaic model that explores the strength of coevolution across the species' distributions. This will be the first application of a geographic mosaic model to presence/ absence of an orchid and its pollinator, and will have important implications in the orchid and pollination fields.

I have identified records for almost 600 species of sexually deceptive orchid species and their confirmed or suspected pollinators. I chose pollinator traits such as body size, mating system, flagellum length of the antennae and sociality as putative resilience or counter-adaptive traits. I am now testing which orchid or pollinator traits are most common, and if they correlate with orchid fitness.

But 'weight' there's more. The effect of the plant hormone auxin on gold kiwifruit size.

Nicola Read | *School of Biological Sciences*

Kiwifruit are an increasingly important crop for the New Zealand (NZ) economy with NZ aiming to reach a return of 4.5B NZD by 2025. An important factor in determining market value is fruit size. Fruit that does not reach a commercially viable size are rejected from the supply chain.

Final fruit size is determined early on in development and influenced by final cell number. Cell division and cell expansion are key cellular processes controlling fruit size and are partly regulated by plant hormones. Hormones are signalling molecules bioactive in low (µm) concentrations. The key hormones involved in regulating fruit size in many fruits are auxin, cytokinin and abscisic acid. Synthetic hormones also influence fruit size. The synthetic cytokinin (CPPU) can increase Actinidia deliciosa (green kiwifruit) size, but this is often administered in high concentrations with adverse effects on naturally occurring hormones.

Interestingly, A. chinensis (gold kiwifruit) fruit are less responsive to CPPU, suggesting different mechanisms may be important. In apple, physiological concentrations (1 µm) of the auxin Indole Acetic Acid (IAA) resulted in an increase of fruit size due to enhanced cell expansion1. We aim to determine the effect of physiological concentrations of hormones on gold kiwifruit size at a physiological and cellular level, to understand the regulation of kiwifruit size. Gold kiwifruit were treated with 1 µm IAA across early development to determine the effect on fruit size. We measured fruit and sampled tissue for microscopy and expression analyses throughout early development. The expression of previously identified candidate genes was compared between IAA-treated and control fruit, to identify underlying mechanisms controlling fruit size. Fruit treated earlier in development were significantly bigger at maturity compared to control and other treatments. This suggests that IAA may be a limiting factor in gold kiwifruit development. Further microscopy analyses and gene expression analyses will reveal the underlying molecular processes.

1. Devoghalaere, Fanny et al. 2012. "A Genomics Approach to Understanding the Role of Auxin in Apple (Malus X Domestica) Fruit Size Control." BMC Plant Biology 12(1): 7

The price of sex: investigating the costs of weaponry in New Zealand harvestmen

Erin Powell | *School of Biological Sciences*

Across animal taxa, sexual selection drives males to brandish exaggerated structures, weapons, used in male-male competition to secure access to mates. Weapon size is constrained by the ability to acquire resources and expected to act as an honest signal of quality, conveying information about an individual's fighting aptitude to opponents. As such, males of a single species can exhibit extreme variation in weapon size and less commonly, weapon shape. To explain the evolution and maintenance of weapon polymorphism, studies have focused on exploring the morphological and behavioural costs and compensatory traits that allow males to bear the most extreme weapons, yet few have utilized a physiological approach. We predicted that males should pay high metabolic costs to maintain large weaponry and associated muscle, ensuring these structures are honest signals of quality. Males of the New Zealand harvestmen (Arachnida, Opiliones) Forsteropsalis pureora, bear exaggerated chelicerae (jaws) which exhibit extreme variation in both weapon size and shape. Using this uniquely polymorphic species, we tested whether resting metabolic rate (RMR) was driven by weapon size and weapon muscle mass. Contrary to our predictions, we found that males with the largest weapons (measures of chelicera width and chelicera length) had lower RMR than small males. Muscle mass and RMR had no significant relationship, suggesting that weapon muscle is not costly to maintain at rest. Despite lower measures of RMR, large males may have a high aerobic scope, with the capacity to ramp up active metabolism during contest, or switch to anaerobic respiration to produce short bursts of power. If small males are utilising alternative reproductive tactics such as scrambling for mates rather than engaging in contest to defend resources, higher RMR may reflect this strategy. Our approach reveals physiological variation rarely considered in the pursuit to understand the evolution of diverse exaggerated structures.

More Trees – Fewer Wasps

Julia Schmack | *School of Biological Sciences*

Worldwide, invasive species have become a major threat to native ecosystems. They deteriorate food webs and can cause species extinctions. Globalization and climate change increase the probability of species introductions and facilitate their spread. Social behaviour enables some insects to become a particularly efficient and harmful group of invasive animals. Social Vespidae wasps, Vespula and Polistes, have successfully invaded New Zealand's native ecosystems including unique offshore islands. The common wasp V. vulgaris and the German wasp V. germanica cause severe ecological and economic damage to native taxa, apiculture and tourism in New Zealand. In South island beech forest (Nothofagus spp.), they significantly reduce the standing crop of an important carbohydrate resource and thereby, outcompete native birds, lizards and invertebrates. Furthermore, Vespidae larvae need invertebrate prey as their protein resource; in high wasp density areas, the survival rate of vulnerable native spiders and caterpillars is zero. Though invasive wasps are widespread throughout New Zealand, little is known about their abundances and impacts in low-density areas. For this study, we measured wasp abundances on 36 offshore islands off the east coast of New Zealand's North Island and recorded a range of environmental and biotic parameters that could promote or inhibit wasp numbers. Vespula wasp numbers negatively correlated with the amount of vegetation cover present on islands. We showed that a high volume of vegetation cover inhibits the abundance of invasive wasps on offshore islands. Furthermore, biogeographic factors such as island size and distance to the mainland explained Vespula wasp numbers on islands: the further away and the smaller an island the lower the wasp abundances. This information can help to develop long-term strategies to enhance ecosystem resilience. We hope our findings inform decision makers in conservation projects and help develop efficient control strategies for invasive insects.

New Zealand's Hidden Forest – Searching for novel antimicrobials

Shara van de Pas | *School of of Biological Sciences*

As the world enters an era of multi-drug resistant bacteria with few treatment options available, researchers are attempting to discover and develop new antibiotics. Due to our geographic isolation New Zealand is home to many fauna and flora found nowhere else in the world. Our fungi are no exception to this and make up almost 20,000 of our microbial species. Fungi are a good source for the discovery of antibiotics; penicillin was isolated from a Penicillium fungus, and the cephalosporin class of antibiotics were first isolated from a Cephalosporium fungus.

One barrier to the discovery of antibiotics from fungi is whether the fungi produce such compounds under laboratory conditions. Our lab has adopted a 'semi-OSMAC' (one strain many compounds) approach. Where several fungi are exposed to a few different conditions and screened for their ability to produce antibacterial compounds against the important human pathogens Escherichia coli and Klebsiella pneumoniae. To achieve this, we are culturing the fungi in the dark or in the light while growing on one of six different media: potato dextrose agar (PDA), malt extract agar (MEA), water agar (WA), czapek extract agar (CEA), rice extract agar (REA), and oatmeal extract agar (OEA). We are also exploring how fungal age impacts on the production of antibiotics. To date, we have screened 25 native New Zealand fungi using this approach and identified 11 with antibiotic activity. Our results indicate that their activity varies depending on the media and growth conditions. We are currently preparing extracts from these fungi to identify the compounds responsible for the antibacterial activity.

New on the Physics Menu: Superconducting Sandwiches!

Andrew Chan | *School of of Chemical Sciences*

Between two pieces of bread is a world of unlimited possibilities to discover exciting new flavours. As scientists with access to advanced layering technologies, we procure our own sandwiches with atomic-level precision - combining mutually exclusive phenomena such as superconductivity and magnetism to study their interplay. Superconductors carry electrical current with zero resistance (i.e. no energy loss) when cooled below its critical temperature (Tc). Near-universally, however, superconductivity is degraded by large magnetic fields or electric currents – a key performance limitation bottlenecking emerging superconductor technologies.

Recently, we discovered surprising emergent properties in thin-film multilayers of a cuprate high-temperature superconductor ($YBa_2Cu_3O_7$) and magnetic manganite ($Pr_{0.5}La_{0.2}Ca_{0.3}MnO_3$). At low temperatures, this 'superconductor sandwich' hosts an exotic granular superconducting state characterized by a phase-pinned superconducting condensate and an unusually high resistance. Surprisingly, the customary superconducting state is recovered in a large magnetic field and/or current, making our sandwiches

one of just four systems exhibiting magnetic field and electric current induced superconductivity (and unique amongst high-temperature superconductors)! As interesting as these sandwiches are, they are unfortunately unsuitable for human consumption. Rather, once we gain a better understanding of their novel physics, they may be destined as components in tomorrow's electronic devices e.g. as superconducting spin-valves or as components for quantum computing.

Why I Need Nuclear Power!

Timothy Christopher | *School of Chemical Sciences*

Since the report of Li^+ conductivity in garnet materials $Li_7La_3M_2O_{12}$ (M = Ta, Nb) lithium garnets have shown to be promising Li^+ conductors which could act as an electrolyte in next generation lithium ion batteries. Research into new lithium garnets need to able to explore the garnet structure and help to determine changes in lithium conductivity and occupancy with changes in garnet composition. The structure of these garnet oxides can be investigated and determined with the technique of diffraction. Here we present a brief comparison of two different forms of diffraction analysis, X-ray diffraction and neutron diffraction. When X-rays and neutron interact with matter they have the ability to scatter. This scattering is determined by the nature of interaction with the incident beam (X-rays or neutrons)and the matter's ordered structure. This scattering is governed by Braggs Law of $n\lambda = 2d\,sin\theta$. X-rays produced with Cu kα_1 radiation generate X-rays with a wavelength of 1.54 Å. Neutrons filtered with a Ge^{115} monochromator can remove unwanted wavelengths producing neutrons with a wavelength of 1.62 Å. As the wavelengths of Cu kα_1 soured X-rays and Ge^{115} filtered neutrons are close to one another, similar diffraction patterns for each method of diffraction should be observed if their interaction with matter is the same. X-rays interact with the electron density surrounding the nucleus while neutrons interact with the nucleus itself. X-ray diffraction shortcomings are with little elements which do not support a large electron density such as oxygen and lithium, important to garnet structural analysis. Neutron interacts and diffracts with lithium and oxygen which gives greater insight into the garnet structures as compared to X-ray diffraction. As available for neutron beamlines is limited both neutron and X-ray diffraction will be useful in helping to investigate new materials for lithium battery electrolytes.

Synthetic Strategies Towards Avi(Me)Cys-Containing Peptides

Elyse Williams | *School of Chemical Sciences*

Antimicrobial resistance (AMR) is projected to cause over 10 million deaths per year by 2050, if action is not taken. Despite this, the antibiotic pipeline has only produced seven new and approved antibiotics between 2003-2012, perhaps due to a lack of commercial interest. Therefore, it is crucial for new antibacterial compounds with clinical application to be discovered and methods for their preparation optimised.

Lexapeptide was isolated from a soil bacterium (Streptomyces rochei) in 2016 and exhibits powerful antibacterial activity against a range of multi-drug resistant (MDR) bacterial species (MIC = MRSA 0.52 μM; MRSE 1.03 μM). The complex structure of lexapeptide gives rise to desirable drug-like qualities such as high stability and target selectivity. However, its transition to a clinical setting is hampered by a lack of production methods.

Our aim is to complete the total synthesis of lexapeptide using modern peptide chemistry in conjunction with enzymatic catalysis. Following this, clinical evaluation of lexapeptide will be carried out to determine its efficacy in combating antimicrobial resistance.

Anthracimycin - A New Scaffold for Drug Discovery

Jared Freeman | *School of Chemical Sciences*

Increasing incidence of methicillin-resistant Staphylococcus aureus (MRSA) infections is both a global health and economic issue. Meanwhile, the rate of new antibiotic discovery over the past decade has diminished in the face of rapidly emerging antibiotic resistance.

Anthracimycin is a 14-membered macrolide natural product which displays activity against methicillin-resistant (MRSA) and vancomycin-resistant strains of *S. aureus* (MIC 0.063 mg mL^{-1} and 0.125 mg mL^{-1}, respectively) and B. anthracis (MIC 0.031 mg mL^{-1}). Anthracimycin is also a novel mTOR inhibitor which suppresses proliferation of cancer stem cells in hepatocellular carcinoma cell lines.

Key structural features of anthracimycin include the trans-decalin ring system, the unusual β-keto enol functionality and the rigid 14-membered macrocycle. The complex architecture, known biological activity and unknown mode of action makes anthracimycin an interesting target for chemical synthesis and poses a unique chemical scaffold for drug discovery.

Total synthesis of anthracimycin will permit further investigation of the unknown mechanism of action, and will provide access to key fragments for pharmacophore elucidation via SAR studies. Intramolecular Diels-Alder reactions are a proven method for accessing decalin ring systems, and we aim to employ this powerful chemical reaction to efficiently assemble the bicyclic fragment, thus accelerating the synthesis of a library of analogues.

Centella asiatica (Gotu Kola) - Will it help to preserve this moment in your memory?

Rasangani Sabaragamuwa | *School of Chemical Sciences*

Centella asiatica is an adventive plant naturalized in New Zealand, considered as a weed. However, it is a popular green leafy vegetable used in variety of cuisine in South East Asia, while highly valued as a herbal medicine. Complementing its recognition as a memory booster or nerve revitalizer in traditional medicine, *C. asiatica* possesses a potential to attenuate oxidative stress, a high anti-inflammatory potential, AChE inhibitory potential and ability to reduce accumulation of amyloid plaques. These multifunctional properties make it capable of promoting general neuroprotection as well as arresting multiple disease pathways in neurodegenerative disorders. However, to be used as a therapeutic agent, a proper evaluation should be done of the active ingredients.

This study investigates the optimisation of extraction, profiling of important bioactive compounds, targeted quantification of selected compounds and providing an insight into bioactivity of potential neuroprotective compounds in *C. asiatica* extracts. A special focus will be given to evaluating its potential as a neuroprotectant arresting multiple pathological pathways in Alzheimer's disease.

Ultrasound-assisted methanolic extract contained the highest yield of bioactives giving strong AChE inhibition. UHPLC-MS/MS and GC-MS were used to characterise major triterpenes, phenolics and essential oils, yet further analysis is needed to confirm unknown compounds. A multiple reaction monitoring (MRM) based UHPLC-ESI-MS/MS enabled precise, sensitive and rapid determination of targeted compounds. Winter harvested, air dried samples of *C. asiatica* leaf extracts comprised of high amounts of triterpenic glycosides with insignificant quantities of aglycone levels compared to those reported elsewhere, indicating the occurrence of a distinct chemotype of *C. asiatica* found in New Zealand. Current bioactivity tests showed promising results, especially strong AChE inhibitory activity which is essentially significant in memory loss. Further investigations are carried out to evaluate its effect on amyloid aggregation activity, which is a major culprit in Alzheimer's brain.

Blockchain-based Scalable and Trustworthy File Sharing

Shujie Cui | *Department of Computer Science*

In blockchain-based systems, malicious behaviour can be detected using auditable information in transactions managed by distributed ledgers. Besides cryptocurrency, blockchain technology has recently been used for other applications, such as file storage. However, most of existing blockchain-

based file storage systems cannot revoke a user efficiently when multiple users have access to the same file that is encrypted. Actually, they need to update file encryption keys and distribute new keys to remaining users, which significantly increases computation and bandwidth overheads. In this work, we propose a blockchain and proxy re-encryption based design for encrypted file sharing that brings a distributed access control and data management. By combining blockchain with proxy re-encryption, our approach not only ensures confidentiality and integrity of files, but also provides a scalable key management mechanism for file sharing among multiple users. Moreover, by storing encrypted files and related keys in a distributed way, our method can resist collusion attacks between revoked users and distributed proxies.

Beyond the vulnerability paradigm: Expanding the capabilities of people with disabilities in disaster risk reduction

Khanh Ton | *School of Environment*

The vulnerability paradigm widely adopts a resource-based approach for examining disaster risk. Accordingly, the vulnerability of people with disabilities' (PWD) to disasters arises from the lack of resources or access to resources. It is argued, however, that frameworks under this approach focus mainly on means (i.e. resources) but overlook ends (i.e. what people are capable of doing or being to cope with disasters). Furthermore, the resource-based approach neglects the processes or factors that are involved in converting resources to meaningful activities and states. Therefore, to bridge these gaps, a human capability-centred framework has been proposed as an alternative approach to better understand disaster risks faced by PWD. This framework considers disaster risk facing PWD as a consequence of the deprivation or lack of capabilities to cope with disasters and this deprivation results from the shortage of not only resources but also enabling conversion factors. Thus, to reduce disaster risk for PWD, it is critical to expand their capabilities to cope with disasters. This can be achieved by fostering meaningful participation of PWD as well as their representative organisations in decision making processes impacting on their well-being not only in times of disasters but also in everyday life. Examining the disaster risk facing PWD through the lens of the capability approach has also raised possibilities of applying this approach for understanding disaster risk facing other groups of people in society.

Bringing the Climate Change Conversation to the Table

Kelly Bingham | *School of Environment*

Animal agriculture is responsible for approximately 15% of global greenhouse gas emissions (FAO, 2014). Reducing meat consumption is therefore one climate change mitigation strategy that individuals could use to reduce their carbon footprints. To date, however, this strategy has been unpopular, and levels of global meat consumption continue to increase. It is important to understand the factors that dissuade people from reducing their meat intake as a climate change mitigation strategy.

This research investigated willingness to reduce meat consumption amongst School of Environment students at the University of Auckland. The research aimed firstly to determine whether students were knowledgeable about the relationship between meat consumption and climate change, and secondly, to explore the factors that make students reluctant to reduce their meat intake as a climate change mitigation strategy.

A web-based questionnaire asked participants about their meat consumption and the factors making them reluctant to change their levels of consumption. This was completed by 105 School of Environment students. A follow-up focus group with four students collected qualitative insights to support the quantitative data.

Most School of Environment students currently do not make dietary choices that align with their stated values and intentions around climate change mitigation; levels of meat consumption were high amongst students despite concern about climate change and high levels of knowledge about the relationship between meat consumption and climate change. The main factors dissuading them from closing this gap between values and behaviours are the strong social norms which encourage meat consumption, and the perception that meat-free meals lack sensory appeal. Making meat free meal options more appealing, both in terms of sensory appeal and social acceptance, could boost engagement with this form of climate change mitigation.

The role of a high altitude active geothermal system in mobilizing metals through a Miocene ore deposit at Jaraña hot springs - Puno-Peru

Diana Pajuelo Aparicio | *School of Environment*

Hot springs are part of the surface expression of complex sub-surface geothermal systems. Concentration and saturation of chemical components in geothermal waters allows the precipitation of deposits such as sinter (silica-based), travertine (carbonate based), or salt deposits. Depending on the composition, these deposits may also contain enrichments in economically important elements. The Jaraña hot springs, located in Peru, discharges alkali-chloride and acid-sulphate, neutral pH water in a range of 55 to 74°C. Fluids are transported through host-rocks previously enriched in economic metals (e.g. porphyry and epithermal deposits). Prior studies indicate that precipitates are enriched in elements such as Ag, Cu, Pb, As, Sn and Fe. The aim of this study is to understand the depositional history of economically important metals in active geothermal systems developed in these high altitude environments.

A new systematic collection of precipitates from the Jaraña hot springs are analyzed by X ray diffraction (XRD), scanning electron microscopy (SEM), and multi – acid digest ICPMS/ICPAES. The main mineral components of these layers include calcite, hematite and gypsum, however SEM results show a small amount of silica precipitation, coating earlier deposited minerals. The presence of economic metals as Cu, Mo and Zn have also been identified in specific layers of Fe-rich travertine (carbonate).

The precipitates register the dynamic deposition history and the importance of changes in water composition over a short period of time. Ongoing studies are fingerprinting sources of metal (e.g. Cu, Mo, and Zn) enrichment within zones of interest, in particular the Fe-rich travertine deposits, to understand the relationship between fluid chemistry, metal transport, and precipitation/deposition.

A new, rapid and non-destructive approach to tephra fingerprinting: µ-XRF core scanning (Itrax)

Leonie Peti | *School of Environment*

Future climate scenarios and volcanic hazard forecasts rely on the geological record of past events and conditions. An important archive for studying the past are lake sediments, which have accumulated in volcanic craters in the Auckland volcanic field (AVF). The crucial component to reliable interpretation, however, is robust chronology development.

Volcanic eruptions have covered wide areas of New Zealand's North Island with tephra (ash) layers many times in the last 1-2 Ma. Due to their instantaneous deposition, tephra layers serve as isochrons for inter-core correlation, and, if the eruption has been dated independently, as important age markers for chronology development. Most layers have distinct geochemical compositions, which allows correlation and assignation to their source eruption, once the composition is quantified. However, the traditional approaches are time-consuming and destructive, making the application of non-invasive µ-XRF core scanning advantageous for tephra identification.

Here, we investigate the potential of the Itrax µ-XRF core scanner (located at the School of Environment, University of Auckland) to differentiate between rhyolitic tephra layers sourced from various northern New Zealand rhyolitic volcanic centres. These tephra layers are usually visibly distinct from the surrounding dark, organic-rich sediment, although attribution to their source volcanic centre and eruption typically requires chemical fingerprinting. We demonstrate that differences in relative abundance of major, minor and trace

elements of most rhyolitic tephra measured by μ-XRF core scanning are sufficiently large to allow separation and identification of the layers. Through multivariate statistics, we highlight the potential of this new, rapid and non-destructive approach to fingerprinting tephra layers and thus improving interpretations of paleoclimate conditions and past volcanic eruptions.

A large database of standard μ-XRF values of a large variety of tephra layers is necessary to apply an envisaged machine learning approach to the non-destructive identification of volcanic ash in sediment cores in the future.

Oxygen Deprivation: Can what doesn't kill you really make you stronger?

Hayden M Green | *Department of Exercise Sciences*

Military pilots are regularly exposed to hypoxia (low oxygen) in training exercises designed to simulate conditions during a decompression emergency. It is assumed that these hypoxic experiences, which are not without risk, will improve their ability to recognise hypoxia symptoms and perform the mental tasks required to self-rescue in a real emergency. However, the utility of these exercises has not been investigated scientifically. Does a previous exposure to hypoxia improve tolerance and awareness during a future hypoxic event?

25 participants completed two tests, one month apart. The test involved breathing a low oxygen gas simulating an altitude of 10,000m. Participants performed a simple card recognition task by identifying playing cards on a screen every 4 seconds. Participants identified cards until losing useful consciousness. They recalled the number of errors they remembered making and graded the severity of hypoxia symptoms experienced during the test.

No improvements were found between tests in time of useful consciousness or the number of task errors. On average, participants made 8 errors, but only recalled making 2. There were no differences between tests in the severity of symptoms. There was no improvement in symptom awareness or a greater tolerance to hypoxia during the second test.

What does this mean? The absence of any improvement in the task, tolerance, and/or awareness of hypoxic symptoms suggests that previous hypoxic experiences alone do not improve performance during oxygen deprivation. The potential risks associated with the physiological stress and loss of consciousness during hypoxia questions the utility of hypoxia training, especially in unscreened and non-medically supervised participants.

Life in an intertidal oven

Jessica Moffitt | *Institute of Marine Science*

The frequency and intensity of heat waves is increasing globally, resulting from anthropogenic climate warming. Heat waves act as more direct drivers of adaptation to climate change; inducing an immediate physiological response, resulting in reduced fecundity or death. When emersed intertidal organisms reside close to their physiological bounds; small increases in temperature have the potential to push organism past their physiological thresholds. Determining how communities will respond to acute thermal stress is paramount in predicting vulnerability to climate change. Acute thermal stress facilitates physiological and behavioural responses, which are used to predict outcomes of climate change. Indirect effect, resulting from changes in interaction strength between species modulate expected outcomes. Intertidal zonation patterns are restricted by both physiological tolerances and species interactions, therefore, indirect effects are particularly important. *Haustrum scobina* helps to regulate zonation patterns on New Zealand's rocky intertidal shores. Yet, their response to acute heat stress is poorly understood. We investigate the direct and indirect effects of heat waves on *H. scobina*. Lethal and sub-lethal bioassays were used to determine the thermal tolerance of *H. scobina* borers across three life stages (Embryos enclosed in egg capsules, juveniles and adults). Indirect effects were assessed by the thermal tolerance assessment of two prey species, *Saccostrea glomerata* and *Chaemosipho spp*. Further, the implications of starvation on thermal tolerance was considered for *H. scobina* adults. The in-situ thermal environment was assessed using infrared imagery alongside environmental temperature measurements. Experimental procedures will be replicated in summer and winter to investigate impacts of proximate thermal history on adult specimens. Heat waves can impact H. scobina, even if they prove heat tolerant; as prey mortality results in reductions in food availability. Changes in oyster borer populations, via both direct and indirect effects, may result in alterations of zonation patterns along New Zealand's rocky intertidal coasts.

Preliminary analyses of New Zealand scampi diet using metabarcoding

Aimee L. van der Reis | *Institute of Marine Science*

Deep sea lobsters are highly valued for seafood and provide the basis of important commercial fisheries in many parts of the world. Despite their economic significance, relatively little is known about their natural diets. Microscopic analyses of foregut content in some species have suffered from low taxonomic resolution, with many of the dietary items difficult to reliably identify as their tissue is easily digested. DNA metabarcoding has the potential to provide greater taxonomic resolution of the diet of the New Zealand scampi (*Metanephrops challengeri*) through the identification of gut contents.

In this DNA metabarcoding study, two universal primer pairs targeting the 18S rRNA and COI genes were used to amplify DNA extracted from both the foregut and hindgut contents of the New Zealand scampi. The amplified DNA was sequenced and then cleaned before being matched to the finest taxonomic level possible, using gene appropriate databases.

The COI gene was found to be more effective than 18S rRNA gene for identifying large eukaryotic taxa from the gut contents, whereas 18S rRNA gene identified mostly smaller marine organisms such as plankton and parasites. This preliminary analysis of the diet of the New Zealand scampi identified a range of species (13,541 reads identified as diet), which included the ghost shark (*Hydrolagus novaezealandiae*), silver warehou (*Seriolella punctate*), tall sea pen (*Funiculina quadrangularis*) and the salp (*Ihlea racovitza*), suggesting that they have a varied diet, with a high reliance on scavenging a diverse range of pelagic and benthic species from the seafloor.

What's inside the pipe?

Eun Sig Pascal Cheon | *Department of Mathematics*

Monitoring hidden fluid flows is one of the most important industrial applications because it can be used to prevent blockages and ensure efficiency in product pipelines. However, often in industrial applications, the pipelines are not transparent. Even if they were transparent, the fluid flows themselves are usually too fast to monitor with human eyes. Furthermore, the monitoring must be on-line with the measurements. This means that for the monitoring must also be very fast. The computational speed requirement can reach up to "1 monitoring computation" per millisecond.

The topic of pipeline imaging has been studied previously. Commonly, an electrical measurement modality known as electrical impedance tomography (EIT) is used. Using the measurement acquired from the EIT and with mathematical modelling, the monitoring reconstructions are carried out. However, because the monitoring computations must be carried out very fast, using the high-resolution models in our reconstructions are infeasible. On the other hand, low-resolution models yield inaccurate reconstructions.

One way to carry out the monitoring computations with the low-resolution model while maintaining the accuracy is to marginalise the modelling errors in the model. This is done by computing lots of samples representing possible flows for both cases of high-resolution and low-resolution models. By comparing the two, we can get the models discrepancy that we can incorporate into the low-resolution models in our reconstructions.

In this poster, the monitoring reconstructions using the standard low-resolution model and the marginalised low-resolution model are presented. The reconstructions show the enhancement the marginalised low resolution model brings.

How do surfaces in spacetime behave at infinity?

Shintaro Fushida-Hardy | *Department of Mathematics*

Given a manifold M , a hypersurface in M is a smoothly embedded submanifold of codi- mension 1. Relativists are interested in the properties of constant mean curvature hyper- surfaces of spacetimes, since they form manageable initial datasets.

Let (M, g) be a conformal manifold of dimension at least 3. It is naturally endowed with the standard tractor bundle. We write (M, g, I) to denote a conformal manifold equipped with a scale tractor.

We have constructed a conformal compactification $(\mathrm{M},\eta,\mathrm{I})$ of Minkowski space, such that I returns the Minkowski metric upon restriction to the interior of M , and is null and parallel. We use this to show that spacelike constant mean curvature hypersurfaces of M with non-zero mean curvature are asymptotically hyperbolic.

Another Slice in the Hyperwall

Elle Musoke | *Department of Mathematics*

We study the chemical peroxidase-oxidase reaction whose behaviour has been attributed to the interaction of four chemicals. A chemist could run experiments for an eternity to observe the behaviour of the reaction after each of the infinitely many possible initial concentrations. We take a geometric view point and consider 3D walls in 4D space that separate different patterns of behaviour. Rather than compute the entire 3D wall, we try to identify special 2D slices that help understand properties of the 3D wall. Our work involves the development of state-of-the-art numerical techniques that are based on the so-called continuation of two-point boundary value problems. These ideas and methods are equally applicable to a wide variety of other processes, such as lasers, neurons, and the climate.

Cold Times: Modelling the Earth's Extreme Tipping Points

Morgan Meertens | *Department of Mathematics*

Snowball Earth is a climate state in which the Earth is completely covered in ice. Early snowball Earth models suggested that both small ice cap states and snowball Earth itself could be stable climate states for the Earth system. Since then, an accumulation of evidence shows that multiple Snowball Earth episodes occurred successively, but this was not considered in original models. Questions remain as to how the Earth could have entered and exited from a snowball state. A key factor is the silicate weathering of rocks. A leading theory for entrance into a Snowball state is a hypothesized increase in the weathering rate. With the use of a conceptual climate model coupled with a dynamically increasing silicate weathering rate, this project aims to gain a mathematical understanding of the resulting tipping point in the model from a small ice cap state to the Snowball state.

Uncertainty in the Gravitational Wave Events Rate from the History of Star-Formation in the Universe

Nianqi (Petra) Tang | *Department of Physics*

As predicted by Einstein, the merging of compact remnant binaries such as Neutron star-Neutron star (NS-NS), Neutron star-Black hole (NS-BH), and Black hole- Black hole (BH-BH) produces gravitational wave transients which have been directly detected. The rate of gravitational wave transients correlates with the stellar population in the history of the Universe. Therefore, the study of these transients can transform our understanding of the Universe. We aim to predict the event rates of core collapse supernovae and compact object mergers with constant as well as mixed metallicity across the Universe. We combine event delay-time distribution at different metallicities from the Binary Population and Spectral Synthesis (BPASS) version 2.2 models with the well-established volume-averaged cosmic star formation rate density and the cosmic metallicity evolution to estimate the volume-averaged rates of events looking from the present time. We predict a core collapse supernovae rate which is in line with observational results. We calculate the compact object merger rates based on the same Star-Formation History and estimate rates similar to current Laser Interferometer Gravitational-Wave Observatory (LIGO) estimates. We further show that the rates change over different Star-Formation History, redshift evolution and metallicity evolution in the Universe and predict optimal merger rates.

Are swallowing problems on the hospital menu? Hospitalised older adults with new swallowing difficulties, admitted for unrelated conditions.

Marie Jardine | *Department of Speech Science*

New onset dysphagia (difficulties swallowing) symptoms in older patients during unrelated hospital admissions are well known to the clinician's caseload. However, age-related swallowing changes do not necessarily result in pathological effects. The trajectory from normal age-related alterations to dysphagia during hospitalisation for older adults is not well understood. This means that 'ageing' can be blamed for swallowing difficulties.

The aim of this research is to compare swallowing of hospitalised older adults aged 70-100 years old reporting new dysphagia symptoms during unrelated medical or surgical admissions, to healthy older and younger adults, using quantitative measures of timing (s) and displacement (cm, cm2) on videofluoroscopic studies of swallowing (VFSS).

VFSS of patients aged 70 years and older performed between May 2013 - June 2018 were retrospectively reviewed, and selected consecutively based on inclusion criteria: no history of dysphagia or diagnosis known to affect swallowing (n=52). Demographics, comorbidities, medications, time from admission until VFSS and length of stay were collected from clinical letters and reports. VFSS were compared to healthy older (n=56) and younger adults (n=43). Quantitative analyses were performed using a software programme.

Significant physiological differences seen in hospitalised older adults but not healthy adults, were elevated pharyngeal area ($p<.001$) and pharyngeal constriction ratio ($p<.001$). Significantly increased penetration ($p<.001$), aspiration ($p<.001$) and pharyngeal residue ($p<.001$) were also observed in the hospitalised older cohort.

Reasons for new dysphagia onset during hospitalisation are likely multifactorial and complex. Alongside multimorbidity and polypharmacy, a combination of factors during hospitalisation may tip the balance of age-related swallowing adaptations and compensation toward dysfunctional swallowing and notable dysphagia symptoms. Results indicate that dysphagia symptoms cannot be attributed to age alone. In order to optimise dysphagia assessment and management for our ageing population, care must be taken not to oversimplify dysphagia as a characteristic of ageing.

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

ACHIEVE THE AMAZING